

# Atropine sulfate & 2-pralidoxime chloride auto-injector - Chempack

Required when distributed (EMR, EMT, AEMT)



# Objectives

- At the completion of this education module, the provider will have:
  - An understanding of scene safety and assuring responder safety.
  - An understanding of the physiological effects of nerve agents.
  - Will demonstrate with 100% accuracy the procedure to auto-injection administration.

# Why Now?

- Increased concern for terrorism
- Available in old munitions in US and elsewhere
- Have been successfully manufactured by other countries
- Very lethal



## Homeland Security Advisory System

**SEVERE**

Severe Risk of Terrorist Attacks

**HIGH**

High Risk of Terrorist Attacks

**ELEVATED**

Significant Risk of Terrorist Attacks

**GUARDED**

General Risk of Terrorist Attacks

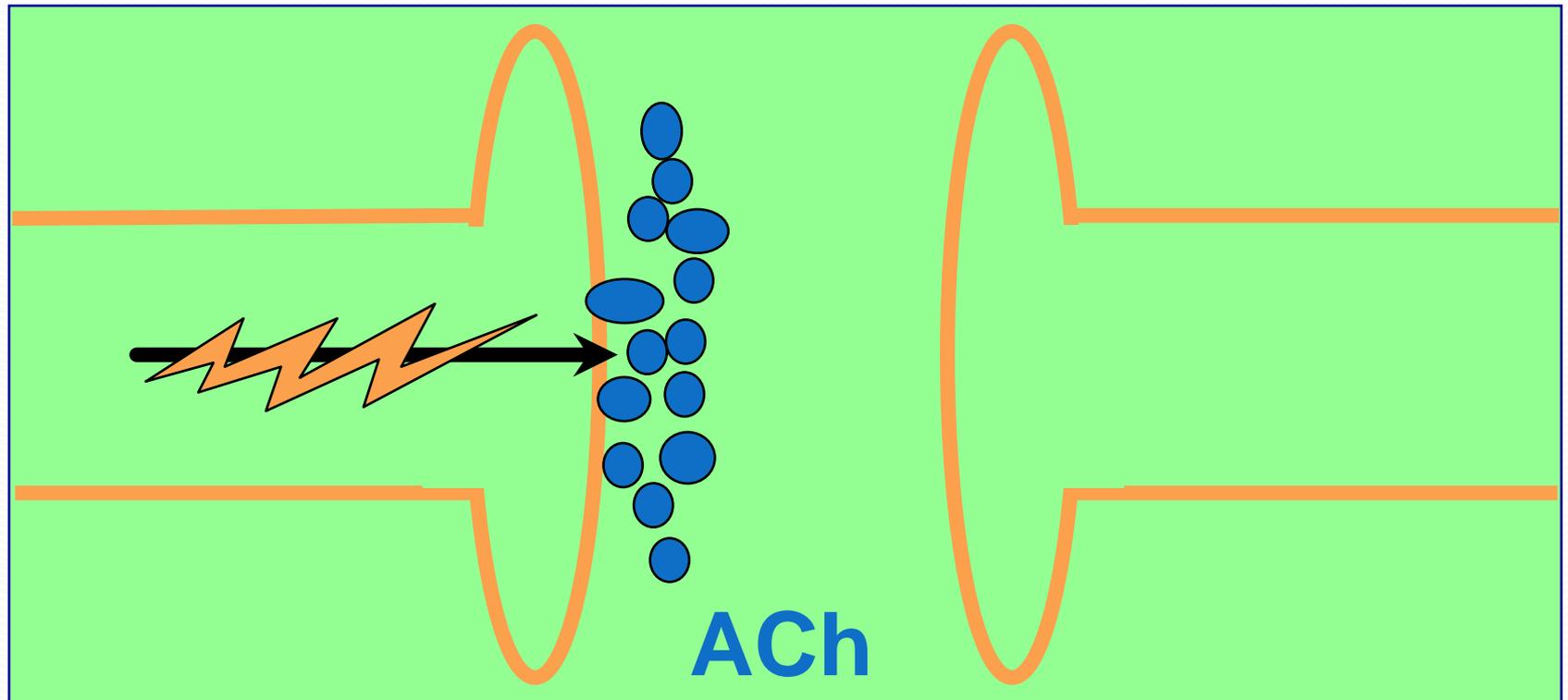
**LOW**

Low Risk of Terrorist Attacks

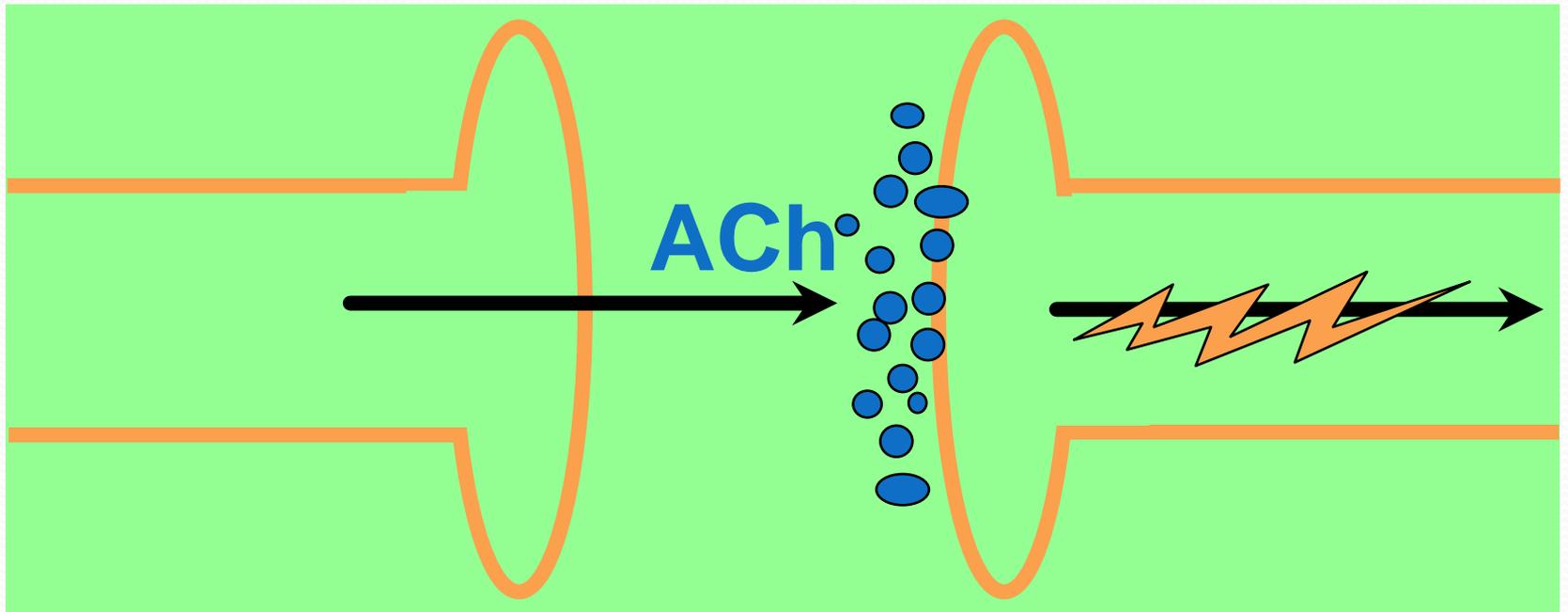
# How it works

- Nerve agents block an enzyme called acetylcholinesterase.
- This enzyme is normally responsible for breaking down acetylcholine that has been used as a neurotransmitter to glands and smooth muscle.
- When it is blocked, the acetylcholine remains in the synapse, causing glands to secrete, and muscles to constrict.
- Death is due from lack of oxygen.

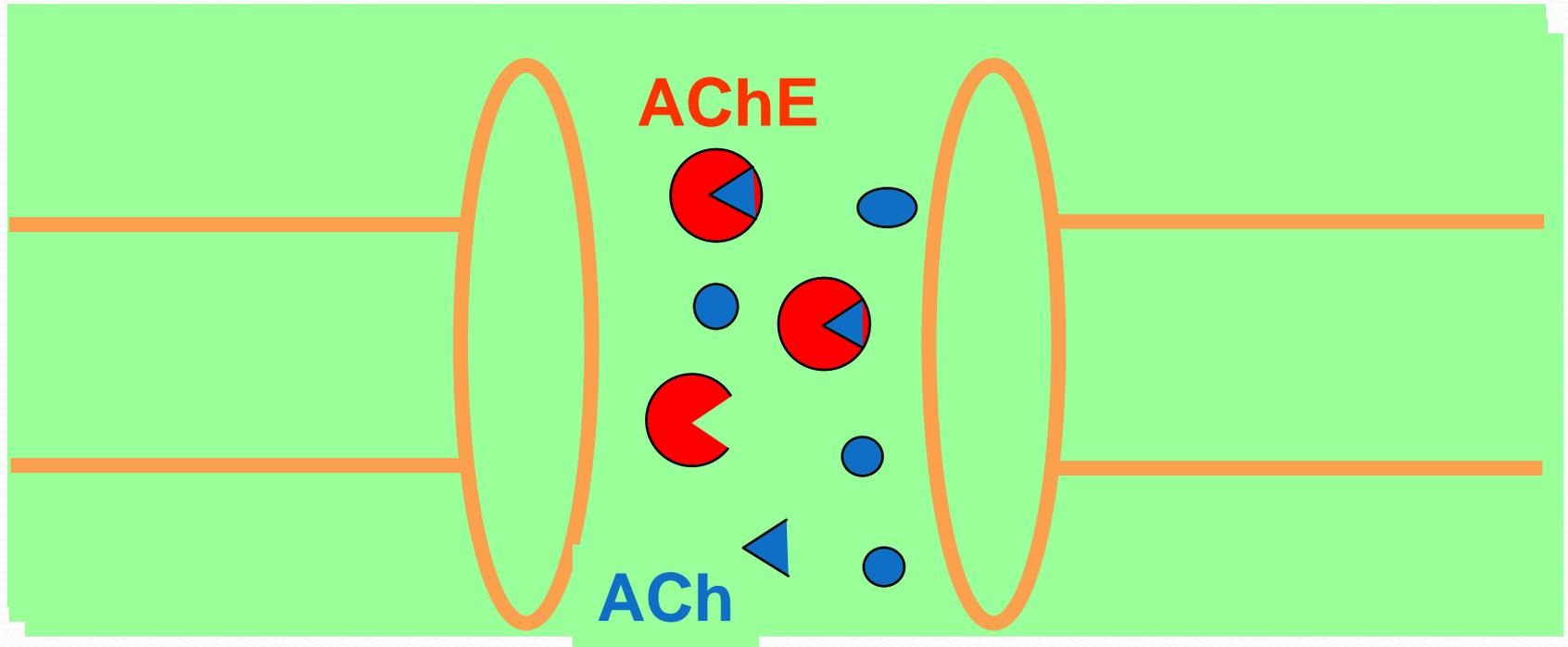
# Normal Nerve Function



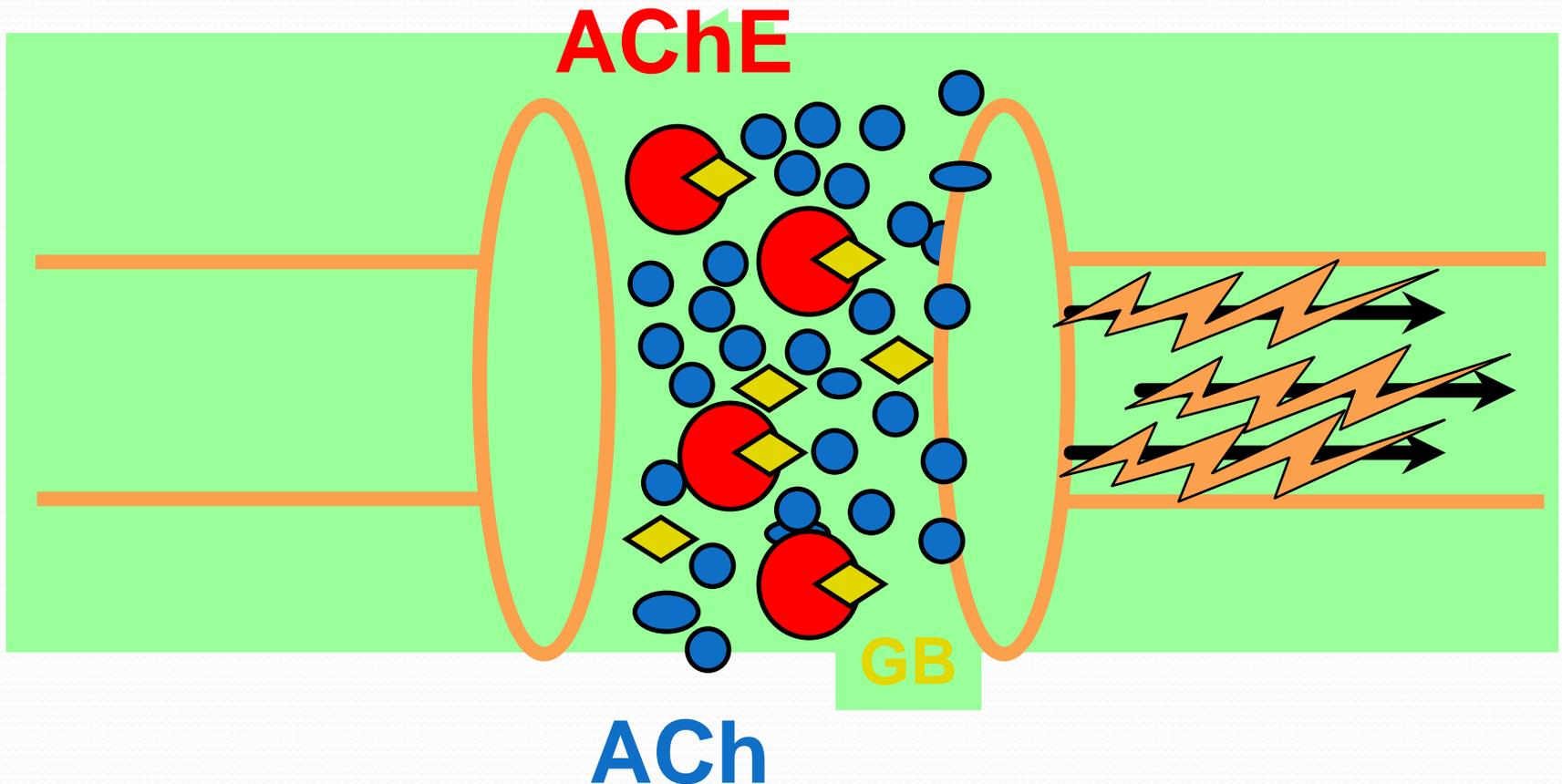
# Normal Nerve Function



# Normal Nerve Function



# How Nerve Agents Work



# Effects

- Acetylcholine is a transmitter in two kinds of synapses, meaning nerve agents function in two ways
- Muscarinic Receptors
  - Smooth muscle
  - Glands
- Nicotinic Receptors
  - Skeletal muscles
  - Autonomic ganglion

# How it works cont.

- The interruption in communication causes overstimulation of these organs or muscles causing hyperactivity
- Effects are seen in the skeletal muscles and smooth muscles (GI tract)

# How it works cont.

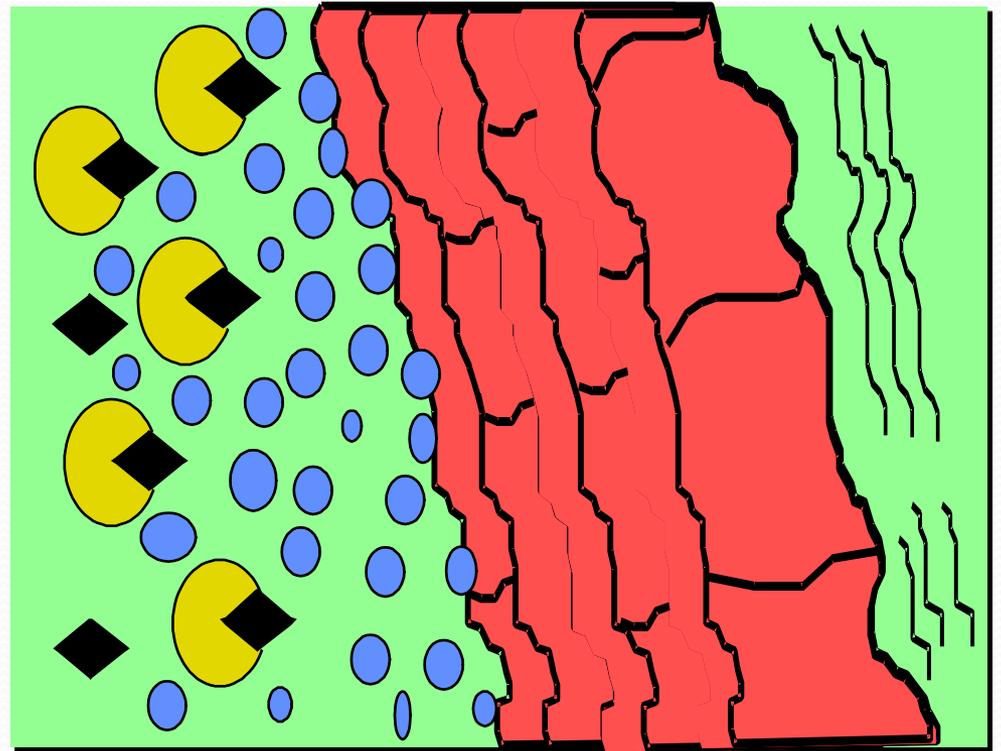
- The glands affected:
  - nose (rhinorrhea)
  - mouth (salivation)
  - eyes (tearing-lacrimation)
  - skin (sweating)

# How it works cont.

- If the agent is inhaled, bronchoconstriction occurs
- Sudden loss of consciousness and convulsions may follow

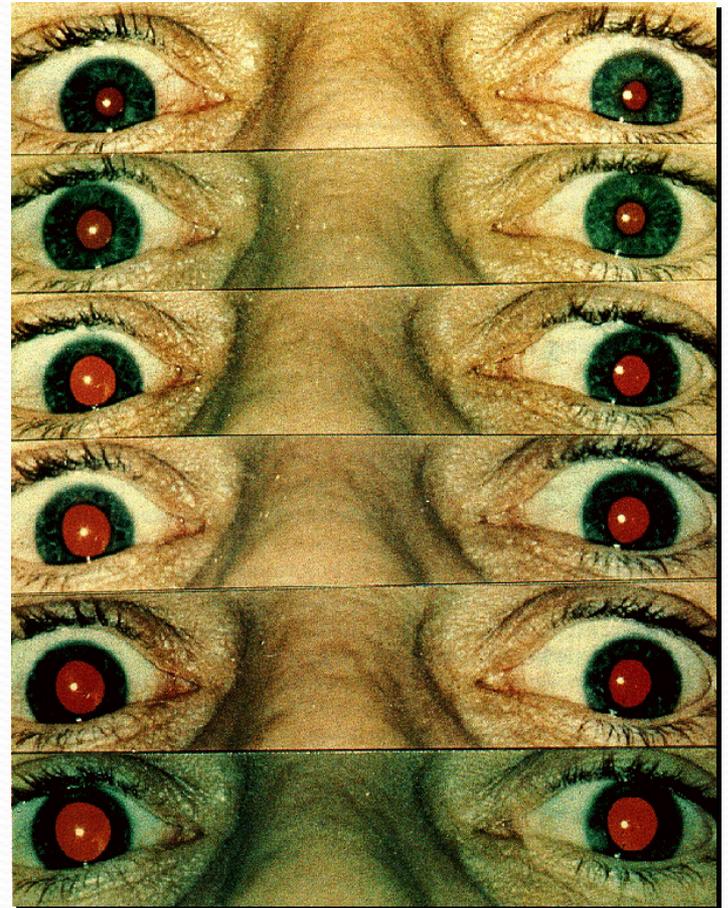
# Effects: Nicotinic

- Skeletal muscle
  - Fasciculations
  - Localized twitching
  - Leads to flaccidity
- Ganglion
  - Tachycardia
  - Hypertension



# Effects: Muscarinic

- Smooth muscle contraction
  - Eyes: miosis-constriction
  - Airway: SOB
    - Severe bronchoconstriction
  - GI: vomiting & diarrhea
- Secretions
  - Saliva, Tears
  - Runny nose (rhinorrhea)
  - Bronchorrhea
  - Sweating



# Overall Effects

- Heart Rate: tachy or brady
- Can get arrhythmias
- Central Nervous System
  - Acute
    - Loss of consciousness
    - Seizures
    - Apnea

# Remember SLUDGEM

- Salivation
- Lacrimation
- Urination
- Defecation
- Gastric upset
- Emesis
- Miosis (pupil constriction), muscle twitching

# Symptoms<sup>[4,5]</sup>

## Mild

- Blurred vision, miosis (excessive constriction of the pupils)
- Excessive, unexplained teary eyes
- Excessive, unexplained runny nose
- Increased salivation, such as sudden drooling

## Moderate

- Chest tightness or difficulty breathing
- Tremors throughout the body or muscular twitching
- Nausea and/or vomiting
- Unexplained wheezing, coughing, or increased airway secretions
- Acute onset of stomach cramps
- Tachycardia or bradycardia (abnormally fast or slow heartbeat)

# Severe Symptoms<sup>[4,5]</sup>

- Strange or confused behavior
- Severe difficulty breathing or copious secretions from lungs/airway
- Severe muscular twitching and general weakness
- Involuntary urination and defecation
- Convulsions
- Loss of consciousness
- Respiratory arrest (possibly leading to death)

# Atropine only treats Muscarinic Effects.

No amount of atropine will stop  
seizures.

Treatment endpoint is airway  
improvement with decreased salivation  
and rhinorrhea

# Signs and Symptoms of Vapor Exposure

- Mild exposure
  - Miosis (dim vision, eye pain), rhinorrhea, slight dyspnea
- Moderate exposure
  - Pronounced dyspnea, nausea, vomiting, diarrhea, weakness
- Severe exposure
  - Immediate loss of consciousness, seizures, apnea, and flaccid paralysis
- Vapor effects occur within seconds, peak within minutes; no late onset

# Signs and Symptoms of Liquid Exposure

- **Mild exposure** (up to 18 hours)
  - Localized sweating
  - Fasciculations
  - No miosis
- **Moderate exposure** (to 18 hours)
  - Gastrointestinal effects
  - Miosis uncommon
- **Severe exposure** (<30 minutes)
  - Sudden loss of consciousness
  - Seizures, apnea
  - Flaccid paralysis
  - Death



**Nerve Agents are highly lethal.**

**No treatment should be undertaken unless proper PPE is worn, or the patient is decontaminated.**

# Types of Nerve Agents

- Sarin (GB)
- Soman (GD)
- Tabun (GA)
- V agent (VX)

# Physical Properties

- Gas vs. liquid
- 4-6x denser than air
- soluble in water
- G agents disperse within several hours
- VX will persist for weeks
- VX>GD>GB>GA lethality

# Persistency

- Term used to describe how long the agent will stay on a surface before it evaporates
- Persistent agents remain on a surface usually longer than 24 hours.

# Volatility

- the ease with which a chemical changes from a liquid to a gas; the tendency of a chemical agent to evaporate.

<b>Name</b>	<b>Code Name</b>	<b>Odor</b>	<b>Features</b>	<b>Onset of Symptoms</b>	<b>Volatility</b>	<b>Route of Exposure</b>
<b>Tabun</b>	<b>GA</b>	<b>Fruity</b>	<b>Easy to manufacture</b>	<b>Immediate</b>	<b>Low</b>	<b>Contact; vapor</b>
<b>Sarin</b>	<b>GB</b>	<b>None</b>	<b>Will off-gas while on victim's clothing</b>	<b>Immediate</b>	<b>High</b>	<b>Primarily resp vapor hazard; extremely lethal if skin contact</b>
<b>Soman</b>	<b>GD</b>	<b>Fruity</b>	<b>Ages rapidly, making it difficult to treat</b>	<b>Immediate</b>	<b>Moderate</b>	<b>Contact with skin; minimal vapor hazard</b>
<b>V agent</b>	<b>VX</b>	<b>None</b>	<b>Most lethal chemical agent; difficulty to decon</b>	<b>Immediate</b>	<b>Very Low</b>	<b>Contact with skin; no vapor hazard</b>

# Transporting Contaminated Patients

- EMS personnel must be wearing PPE.
- If necessary, different triage categories of contaminated patients may be transported together.
- Helicopters do not transport contaminated patients.
- Once an ambulance has been used to move contaminated patients, it may only be used for contaminated patients until decontamination is verified.

# Nerve agents form a vapor, and may be present downwind from a release site.

- Request specific staging information.
- Maintain safe location upwind and uphill.
- Pay strict attention to hot, warm and cold zones.
- Activate ICS.

# Triage

- Immediate: 2 or more body systems involved- airway, convulsing, decreased consciousness, no spontaneous respirations
- Delayed: no immediate life threat, patient without symptoms OR has been given >4mg Atropine and is recovering... observe at least 18 hours
- Minimal: walking and talking, may only have dim vision, pinpoint pupils... observe 18 hours
- Expectant: inadequate resources, complete arrest



# Atropine

- Works on muscarinic effects
- Dose until airway sx resolve, and secretions are drying
- Do not rely on heart rate or pupil size

# Pralidoxime (2PAM)

- Works like a “crowbar” by removing nerve agent from acetylcholinesterase
- More effective if given early, as some of the nerve agents bond “ages” to permanent in under 2 minutes

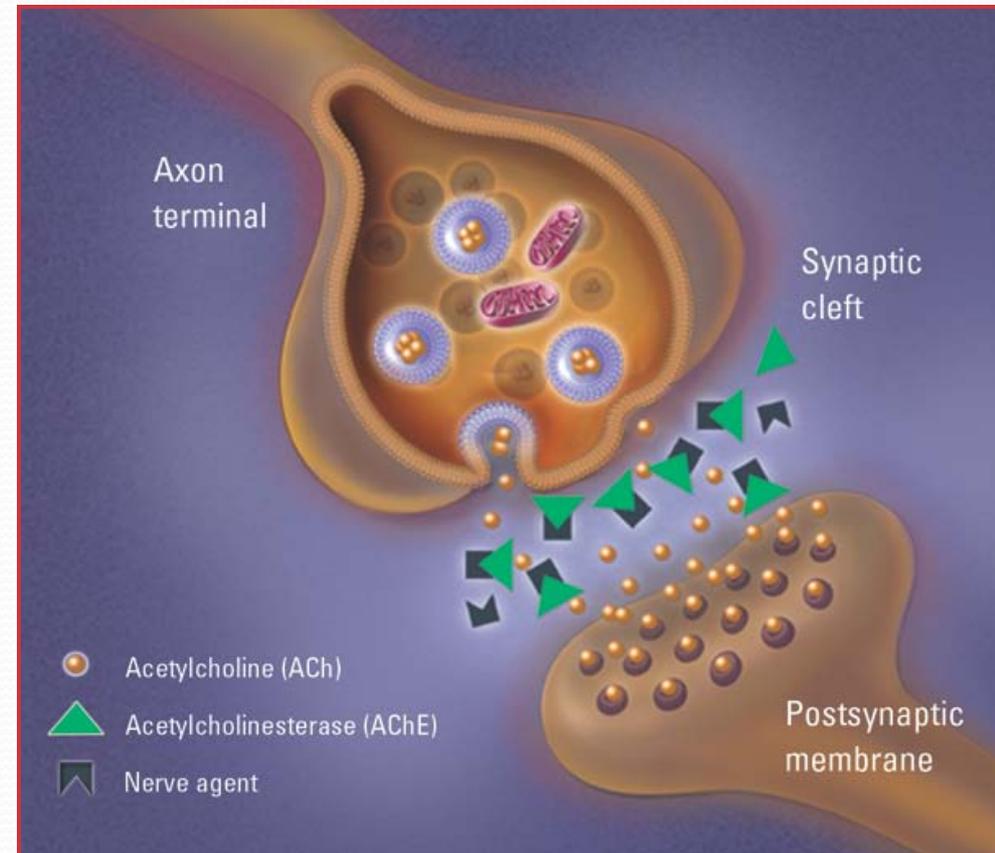


# What is DuoDote™?

- Developed by Meridian Medical Technologies as a streamlined, easy-to-use replacement for the Mark I Kit
- FDA-approved for emergency medical services (EMS) use in the treatment of organophosphorus nerve agent and organophosphorus insecticide poisoning
- Contains 2 antidotes in 1 auto-injector:
  - 2.1 mg of atropine in a 0.7-mL solution
  - 600 mg of pralidoxime chloride in a 2-mL solution
- Features next-generation BinaJect™ delivery technology
  - 2 antidotes delivered sequentially into separate areas of the muscle
  - Easy to use: only 1 injection with 1 needle

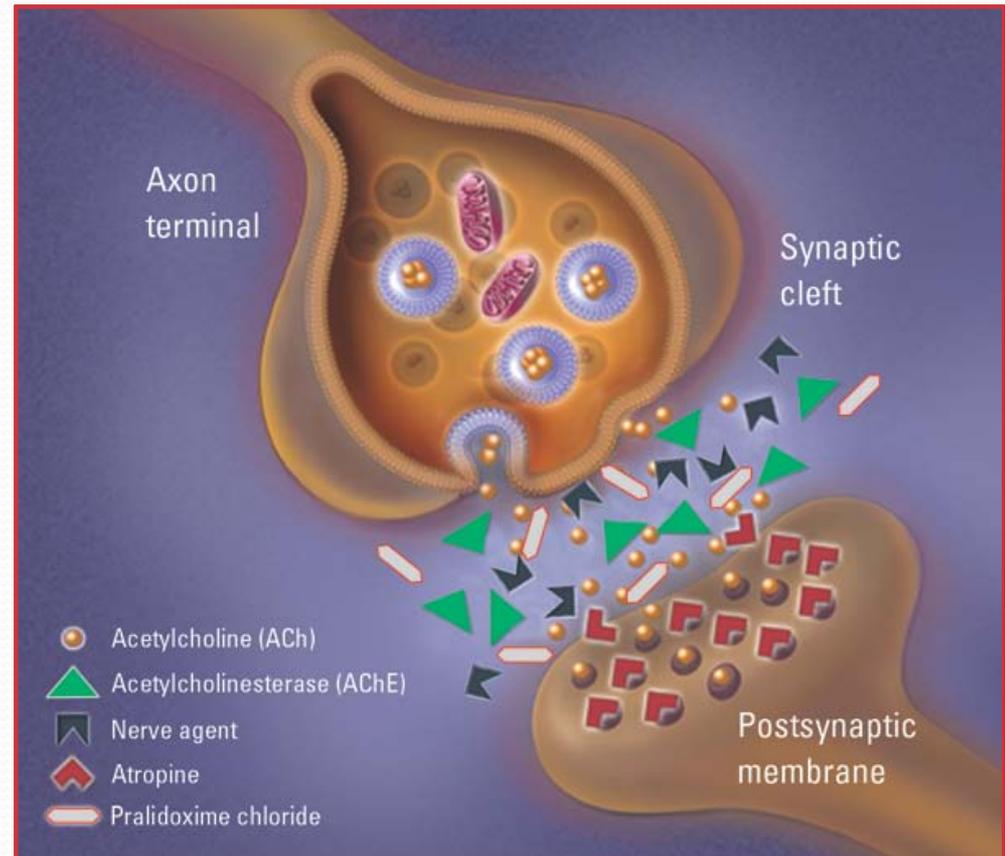
# Where Does DuoDote Work?

- Effects of organophosphorus poisoning:
  - Chemical nerve agents and organophosphorus insecticides cause an excess buildup of acetylcholine (ACh), a neurotransmitter
  - This buildup occurs when the activity of an enzyme called acetylcholinesterase (AChE) is blocked by the nerve agent<sup>4</sup>
  - Blocking AChE results in overstimulation of cholinergic nervous pathways
  - There are 2 types of ACh receptors: muscarinic receptors affect breathing and gastrointestinal functions, while nicotinic receptors affect vascular function and muscle movement<sup>4</sup>



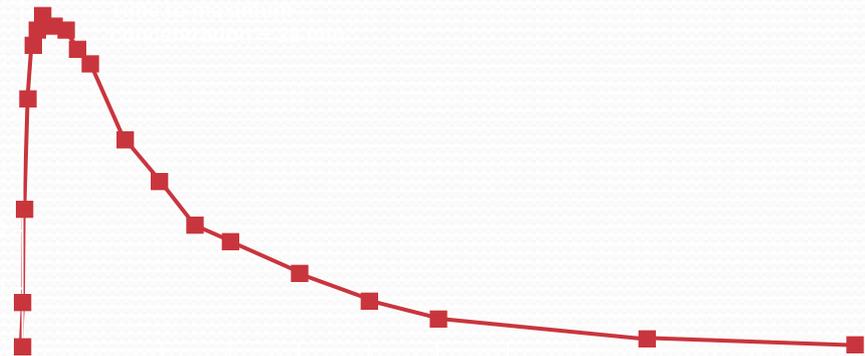
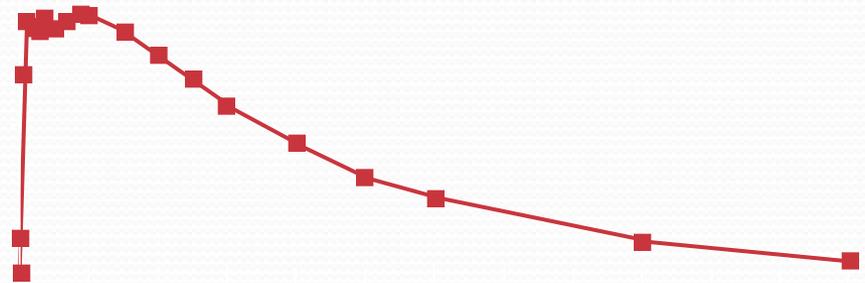
# How Does DuoDote Work?

- Complementary actions:
  - Atropine blocks ACh on the postsynaptic (downstream) side of synapses at muscarinic cholinergic receptors in multiple organ systems, thereby reducing cholinergic overstimulation
  - Pralidoxime chloride reactivates the AChE enzyme, allowing it to resume its function of moderating the activity of ACh once again<sup>1</sup>



# How Quickly Does DuoDote Work?

- After injection, atropine and pralidoxime chloride begin counteracting the effects of organophosphorus poisoning within about 10 minutes
- Both antidotes reach their peak concentrations in the bloodstream within about 30 minutes<sup>1</sup>



# What Happened to MARK-1?

- Mark-1 kits are no longer available for use.
- DuoDote has replaced them
- Here is a slide that compares them side by side

# DuoDote™ Replaces the Mark I™ Kit

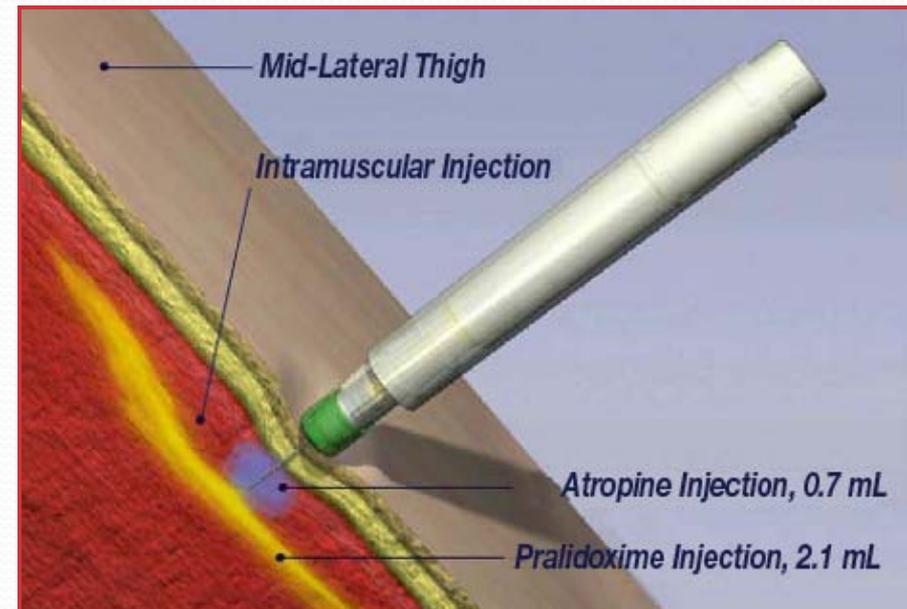
## Delivers the same protection in a single auto-injector

Product Name:	DuoDote Auto-Injector	Mark I Kit <sup>2,3</sup>
		
Active Ingredients:	<ul style="list-style-type: none"><li>• 2.1 mg atropine sulfate equivalent</li><li>• 600 mg pralidoxime chloride</li></ul>	<ul style="list-style-type: none"><li>• 2 mg atropine sulfate equivalent</li><li>• 600 mg pralidoxime chloride</li></ul>
Delivery Mechanism:	1 auto-injector featuring dual-chamber technology	2 auto-injectors, each with a single traditional chamber
Steps to Administer:	Simple administration with just 1 injection	Additional steps required – 2 separate injections
Overall Dimensions:	6" x 1" x 1"	6" x 1.5" x 1"
Shelf Life:	3 years	5 years
Packaging:	Chemically hardened pouch	Foam pouch

# DuoDote Injection

## Instructions

- Select site and inject:
  - The injection site is the mid-outer thigh area. You can inject through clothing, but make sure that pockets are empty
  - Swing and firmly push Green Tip straight down (at a 90° angle) against mid-outer thigh, continuing to push firmly until you feel the auto-injector trigger
  - After the DuoDote Auto-Injector triggers, hold it firmly in place against the injection site for 10 seconds

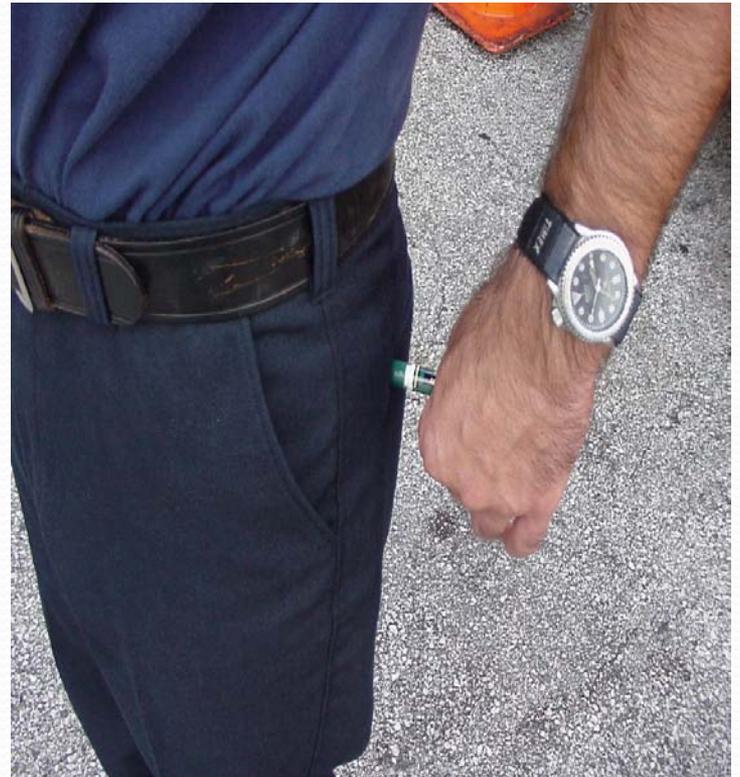






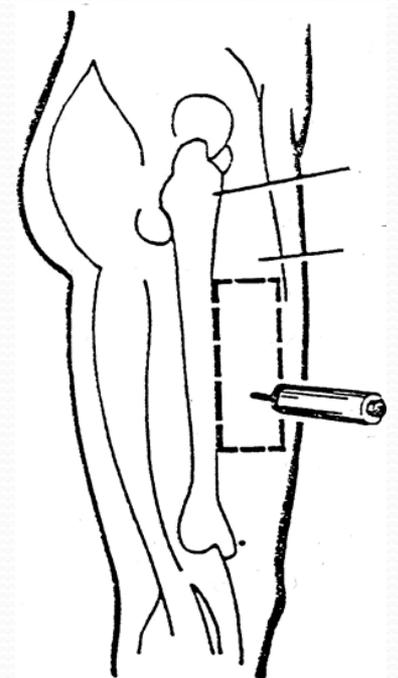
# Self Treatment

- Do not place finger over either end!
- Upper outer quadrant of buttocks is best spot
- Hold in place for 10 seconds



# Alternate location

- Can also use lower, outer quadrant of thigh
- Needle will go right through clothes, turnout, or PPE without problems



# Basic/Advanced Standing Orders

- Routine patient care: Assess for SLUDGEM (salivation, lacrimation, urination, defecation, gastric upset, emesis, miosis/muscle twitching)
- Remove to cold zone after decontamination and monitor for symptoms
- Treatment using DuoDote™ autoinjectors *self and peer only*
- Treatment using DuoDote™ autoinjectors to public *in emergency stockpile release only*

# Basic Standing Orders

- Antidotal therapy should be started as soon as symptoms appear.
- *All injections must be given IM*
- Treatment using DuoDote™ autoinjectors *self and peer only*
- Treatment using DuoDote™ autoinjectors to public *in emergency stockpile release only*

# Adolescent/Adult Basic Standing Orders

- 2 or more minor symptoms
  - One DuoDote™ kit
  - Reassess: if more severe symptoms appear within 10 minutes administer
  - Two additional DuoDote™ kits
- Initial Moderate Symptoms
  - Two DuoDote™ kits
- Initial Severe Symptoms
  - Give Three DuoDote kits AND
  - One autoinjector of Diazepam 10 mg
- May repeat DuoDote™ kit every hour for three hours

# Basic Standing Orders: PEDIATRIC

- DuoDote™ may be used for pedi patients in life threatening situation w/ exposure symptoms
- Child 13-25kg (29 - 55lb) – One DuoDote
- Child 26-50kg (56 - 110lb) – Up to Two DuoDote kits based on progression of symptoms
- Child over 51kg (>110lb) – Up to Three DuoDote kits based on progression and severity of symptoms

# Paramedic Standing Orders: PEDIATRIC

- Children <12 kg (26 lbs):
  - Use of DuoDote kit is not recommended
  - If no other source available after 90 min may consider using one DuoDote kit.
- If child is seizing and >26 (> 57lbs)kg
  - May use one Adult Diazepam injector

# Provider Protection

- If a first responder display symptoms:
  - Notify dispatch immediately
  - Evacuate area
  - Do not reenter until cleared by Hazmat
  - Remove clothing and decontaminate
  - Treatment basic and paramedic same as for mass casualty

# Provider Treatment

- Use only if nerve agent symptoms are present. DuoDote™ kits offer no prophylactic protection and use prior to appearance of symptoms may be harmful. All injections must be given IM.

# Accidental OD

- If First Responder accidentally gives Mark 1 kit to themselves without being exposed to nerve agent
  - Hot
  - Red
  - Unable to sweat (dry)
  - Confusion
- Need to be kept in cool, controlled environment until wears off

# References

- [1] Watson WA, Litovitz TL, Klein-Schwartz W, et al. 2003 Annual Report of the American Association of Poison Control Centers Toxic Exposure Surveillance System. *Am J Emerg Med.* 2004;22:335-404
- [2] Department of Health and Human Services. Centers for Disease Control and Prevention. *Third National Report on Human Exposure to Environmental Chemicals.* Atlanta, GA: National Center for Environmental Health; 2005 NCEH Pub. No. 05-0570.
- [3] Olson KB. Aum Shinrikyo: once and future threat? *Emerg Infect Dis.* 1999;5:512-516.
- [4] Cannard K. The acute treatment of nerve agent exposure. *J Neurol Sci,* 2006;249:86-94
- [5] Department of Health and Human Services. Centers for Disease Control and Prevention. *Third National Report on Human Exposure to Environmental Chemicals.* Atlanta, GA: National Center for Environmental Health; 2005;NCEH Pub No. 05-0570

# Any Questions?

- Lets practice!