

Terrorism and WMDs - Awareness and Response



CHEMICAL AGENTS

[Professor Name]
Course

Chemical Agents

2

□ Categories

- Nerve agents (e.g., sarin, soman, cyclosarin, tabun, VX)
- Vesicating or blistering agents (e.g., mustards, lewisite)
- Choking agents (chlorine, phosgene, diphosgene)
- Blood agents (hydrogen cyanide)
- Riot control agents (e.g., pepper gas, cyanide, CS)
- Vomiting agents (e.g., adamsite)

Chemical Agents – *History*

3

❑ Ancient China

- recipes for toxic smokes dating as far as 1000 BCE
- use of poisonous gas by Mongol army, 1241
- catapulting mud balls filled with noxious substances

❑ Ancient Greece and Rome

- Sparta vs Athens, 423 BCE – noxious smoke created by ignition of wood, tar, and sulfur
- Third Punic War (146 BCE) – Romans made the area infertile by sowing salt
- Greek fire – 673 CE

Chemical Agents – *History*

4

□ The Renaissance

- Leonardo da Vinci – proposed toxic powder and protective masks
- the Thirty Years War
- U.S. Civil War – chlorine gas as an offensive weapon
- Brussels Convention, 1874
- International Peace Conference, 1899

Chemical Agents – *History*

5

❑ World War I

- French forces used teargas grenades
- liquid explosive, turpinite
- use of poison gas by Germans in retaliation
- Fritz Haber – gas cloud proposition, chlorine as a weapon
- British Army – poison gas, chlorine shells
- Phosgene – improved, more effective, harder to detect
- mustard gas

❑ Post World War I

- 1925 Geneva Protocol – 16 nations signed (U.S. in 1975)

Chemical Agents – *History*

6



release of chlorine gas



mustard gas burns

Chemical Agents – *History*

7

□ Interwar Years

- Colonial Secretary Winston Churchill proposed use of mustard gas against Mesopotamia revolt
- Spanish forces against Morocco, 1921-1927
- Italy against Abyssinia, 1935

□ World War II

- Hitler opposed use of mustard gas, however
- ‘medical experiments’ on prisoners by Germany and Japan
- Germany’s accidental discovery of nerve agents

Chemical Agents – *History*

8

□ Post World War II

- Egypt accused of using sulfur mustard in Yemeni Civil War, 1963-1967
- Iraq-Iran War, 1982–1988
 - aerial bombs, sulfur mustard, nerve agent tabun
- The Biological Weapons Convention, 1972
- The Chemical Weapons Convention
 - effective since April 29, 1997
- sarin release in Japan, 1995
- attempted sarin attack by al-Qaeda, 2005

Chemical Weapons – *Nerve Agents*

9

- ❑ phosphorus-containing organic chemicals
- ❑ extremely toxic
- ❑ classified as G-series or V-series
- ❑ G-agents
 - discovered by Germans
 - volatilize and dissipate relatively quickly
 - nonpersistent
- ❑ V-agents
 - persistent and not readily volatile

Chemical Weapons – *Nerve Agents*

10

- ❑ accidental discovery by Dr. Schrader
- ❑ absorbable through skin
- ❑ effects include
 - miosis
 - profuse salivation
 - convulsions
 - involuntary urination and defecation
 - eventual death by asphyxiation

Nerve Agents – *Tabun*

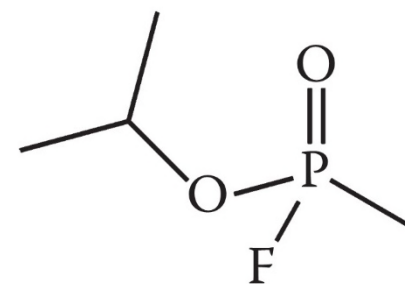
11

- ❑ clear to brown, volatile tasteless liquid, faint fruity odor
- ❑ extremely toxic
- ❑ easier to produce
- ❑ attacks the mammalian nervous system
 - continuous firing of synapses
 - sustained contraction of diaphragm
 - death by asphyxiation
- ❑ irritating to the eyes, liquid deposited on eye kills
- ❑ moderate exposure to tabun can recover completely

Nerve Agents – Sarin

12

- ❑ colorless, odorless liquid
- ❑ similar structure and mechanism of action as tabun
- ❑ discovered by Dr. Schrader in 1938
- ❑ more than ten times as potent as tabun
- ❑ more persistent by addition of petroleum
- ❑ used in Tokyo subway attack, 1995



sarin structure

Nerve Agents – VX

13

- ❑ odorless and tasteless
- ❑ most studied of the V-series, most potent
- ❑ too toxic in insecticides for conventional use
- ❑ 1958, British exchanged research on VX technology for nuclear research with U.S.
- ❑ 1961, U.S. went for large-scale production and weaponizing
- ❑ only United States, France, and Russia known to possess VX
- ❑ 10 times more toxic than sarin by entry through the skin

Nerve Agents – VX

14

- ❑ exposure through inhalation, skin absorption, or eye contact
- ❑ virtually impossible to remove from exposed surface
- ❑ least volatile hence can persist for months
- ❑ heavier than air, does not readily mix with water
- ❑ slow breakdown in body causes cumulative effect
- ❑ treatment through antidotes or chemical agent resistance pills

Nerve Agents – VX

15

❑ Destruction of Stockpiles

- ships with stockpiles sunk
- Newport Chemical Depot, Indiana
- Gulf War, 1990
- 1980–1988 Iran–Iraq War

Choking Agents

16

- ❑ cause irritation and severe coughing
- ❑ Chlorine (Cl)
 - spreads rapidly upon release from liquefied form
 - highly corrosive upon contact with moisture
 - highly water-soluble
 - irritates nasal passages
 - larger quantities cause death by asphyxiation
 - exposures to 1 000 ppm can be fatal

Choking Agents

17

□ Phosgene

- colorless gas
- smell resembling new-mown hay or fresh corn
- used in manufacture of polymers
- incapacitate at lower ppm and fatalities for higher ppm
- coughing, choking, tightness in the chest
- nausea, vomiting, headache
- shock-like symptoms, death in 24–48 hours

Choking Agents

18

□ Diphosgene

- colorless liquid
- destroyed filters in gas masks in WW-I
- hazards similar to phosgene
- body converts diphosgene into phosgene

□ Chloropicrin

- oily, colorless, or pale yellow liquid, strong odor
- irritant
- more toxic than chlorine

Choking Agents

19

☐ Chloropicrin effects

- irritation of the nose
- coughing and difficulty in breathing
- sore throat
- dizziness
- bluish skin
- vomiting
- chemical burns on skin
- fatal if lungs injured

Blister Agents

20

❑ Sulfur Mustards

- forms large, painful, liquid-filled blisters on exposed skin
- colorless, odorless, and viscous liquids
- heavy use in World War I
- effects
 - redness and itching of skin
 - irritation, pain, swelling, and tearing of eyes, also severe pain, or blindness
 - sinus pain, shortness of breath, and coughing, bleeding and blistering of respiratory system at high concentrations
 - abdominal pain, diarrhea, fever, nausea and vomiting

Blister Agents

21

❑ Sulfur Mustards *continued*

- carcinogenic and mutagenic
- one suggested mechanism involves bonding to DNA
 - may lead to cell death
 - disturb natural repair mechanisms
 - mutations
- no antidote or treatment exists
- usually not fatal
- suggested measure is immediate decontamination
- control infections using antibiotics

Blister Agents

22

□ Lewisite

- colorless and odorless liquid
- more volatile than mustard
- discovered by U.S. chemist Winford Lewis
- field trials during World War II
- declared obsolete by the 1950s
- neutralized by oxidation with chlorine and disposed into the Gulf of Mexico

Blister Agents

23

□ Lewisite

- Inhalation effects
 - burning pain to the chest,
 - sneezing, coughing, vomiting,
 - pulmonary edema
- Ingestion effects
 - severe pain, nausea, vomiting
 - tissue damage
- inhibits enzymes
- treatment through British anti-lewisite (BAL, dimercaprol)