APPENDIX C. Chemical Agents

This section provides basic information on four major categories of chemical agents that could be used by terrorists, grouped according to how they affect the human body. These categories are:

- Blister (e.g., mustards)
- Blood (e.g., cyanides)
- Choking (e.g., chlorine)
- Nerve (e.g., sarin, VX agents)

Information on other kinds of chemicals can be found in the media reference guides at http://www.hhs.gov/emergency and at http://www.bt.cdc.gov.

Please note that neither of the media reference guides provides detailed information on toxic industrial chemicals because there are thousands that could potentially be used by terrorists. However, the public health response to a toxic industrial chemical attack or accident would be very similar to the response to an incident involving the chemicals discussed in these guides.

Please note that the descriptions of signs and symptoms in this section are not meant to be used to self-diagnose illness—they are for informational purposes only. Contact a health care provider if you suspect that you have been exposed to one of these agents or if you feel sick.

BASIC FACTS FOR ALL CHEMICAL AGENTS

- Chemical agents can be poisonous gases, liquids, or solids.
- Most of these agents are usually fast-acting and toxic to people, animals, or plants.
- Chemical agents can be deployed in five ways:
  - Spraying with wet or dry aerosol sprayers (e.g., crop dusters, handheld spraying devices)
  - Using a heat source to vaporize the chemical for release
  - Using an explosive device to disperse the chemical
  - Pouring the chemical on a specific site (e.g., floor, sidewalk, subway platform)
  - Contaminating food, water, or pharmaceuticals
- Weather factors (e.g., temperature, wind speed and direction, humidity, and air stability) have an impact on the effectiveness of an open-air release.
- A chemical release may result in environmental clues, including:
  - Dead plants, animals, or insects
  - Pungent odor
  - Unusual clouds, vapors, or droplets
  - Discoloration of surfaces
- Some common immediate physical signs and symptoms from an airborne attack may include:
  - Tightness in chest and difficulty breathing
  - Nausea and vomiting
  - Watery eyes, blurry vision

LESSENING THE IMPACT OF EXPOSURE FOR ALL CHEMICAL AGENTS

- **Follow the instructions of emergency workers, if possible.**
- **Move away from the site of release (if known) during an outdoor release, or go indoors.**
- **Shelter-in-place if indoors near an outdoor release.**
- **Evacuate the affected building during an indoor release.**
- **If exposed, remove contaminated clothing and place in a plastic bag.**
- **Wash with soap and water (when appropriate).**
- **Flush eyes with water (when appropriate).**
- **Seek medical attention if you have breathed in chemical fumes or if chemicals have touched your skin.**
- **Patients should be decontaminated if they have chemicals on their clothes and/or skin (when appropriate).**
- **If medically indicated and available, get appropriate antidote(s).**
- **Consider using protective masks and clothing to minimize exposure.**
- **Whenever possible, get emergency personnel in protective gear to assist in the removal of contaminated clothing.**

CHEMICAL AGENT QUICK REFERENCE CHART

AGENT	DESCRIPTION	FIRST SIGNS AND SYMPTOMS	FIRST ACTIONS	MEDICAL RESPONSE
Blister Agents (e.g., mustard gas, lewisite)	Group of agents that cause blistering or burns on the skin or lungs. Could be transmitted by inhaling, or contact with skin or eyes.	Skin and eye burning, coughing, severe respiratory irritation.	Leave the affected area. Immediately remove clothing, place in a plastic bag, and shower or wash. Seek medical care if exposed.	**Mustard gas:** treatment for blisters as burns, supportive care. **Lewisite:** same treatment; antidote available.
Blood Agents (e.g., cyanide, arsine)	Group of agents depriving cells and tissues of oxygen. Could be released in air, water, or food.	Rapid breathing, nausea, convulsions, loss of consciousness.	Same as for blister agents.	**Cyanide:** antidote. **Arsine:** supportive care; blood transfusions and intravenous fluids may be needed.
Choking Agents (e.g., chlorine, phosgene)	Group of agents attacking the respiratory system. Most likely to be released in air.	Coughing, burning eyes or throat, blurred vision, nausea, fluid in lungs, difficulty breathing.	Same as for blister agents.	Monitoring for delayed signs and symptoms; supportive care (e.g., oxygen as needed).
Nerve Agents (e.g., sarin, soman, tabun, VX)	Group of agents that affect the nervous system. Released in air, water, or food.	Seizures, drooling, eye irritation, sweating or twitching, blurred vision, muscle weakness.	Same as for blister agents.	Antidote; supportive care (e.g., oxygen as needed).

You may notice that specific guidance on food and water safety after a terrorist attack is not included in this guide. The effect of an attack or other public health emergency on food and water supplies is very situation specific. As a result, public health officials will provide specific information on food and water safety as needed.

BLISTER AGENTS

(Examples: mustards, lewisites/chloroarsine, phosgene oxime)

Also called vesicant agents, mustards and lewisites cause blistering on the skin after exposure. Mustard gas is the best known example. A lesser-known but possible threat is lewisite.

MUSTARD GAS

Mustard Gas Basic Facts

- Can be a colorless, oily, odorless liquid
- Can be vaporized to form a gas, if heated
- In some quantities, may have a slight garlic odor and a yellowish-to-brownish tint

Mustard Gas Illness

- Enters the body through inhalation or contact with skin or eyes.
- Causes skin damage on contact, especially on hot, humid days or in tropical climates.
- Typically, signs and symptoms do not occur immediately. It may take 2–24 hours for signs and symptoms to develop.
- Signs and symptoms include:
  - Skin burns, then blisters within a few days; blisters become large and may be yellowish-brown in color.
  - Eyes burning and swelling, which can cause blindness (lasting up to 10 days).
  - If gas is inhaled, may result in coughing, bronchitis, long-term respiratory disease, and cancer in the airways and lungs later in life.
- Exposure is usually not fatal.

INSTRUCTIONS TO SHELTER-IN-PLACE AND SEAL THE ROOM DUE TO CHEMICAL INCIDENTS

If you have been exposed:

- **Remove contaminated clothing if coming from outside and seal it in a plastic bag.**
- **Shower and wash with soap, if possible.**

To shelter-in-place and seal the room:

- **Find a room with as few windows and doors as possible.**
- **Go to the highest level possible.**
- **Turn off the air conditioner, heater, and fans.**
- **Close the fireplace damper.**
- **Tape plastic over windows and doors; seal with duct tape.***
- **Tape over vents and electrical outlets (and any other openings).**
- **Fill sinks and tubs with water.**
- **Turn on the radio for instructions.**
- **Keep a telephone handy.**

* **Note: Within a few hours, the plastic and tape may need to be removed to allow fresh air to enter the room to prevent suffocation. Follow the instructions of emergency workers and/or public health officials.**

Mustard Gas Diagnosis and Treatment

- No effective medical test exists.
- Urine tests can be inconclusive.
- No known specific antidote or treatment exists.
- Supportive medical care is helpful.
- Blisters should be treated as burns.
- If swallowed, do not induce vomiting. Give milk to drink.

LEWISITE

Lewisite Basic Facts

- Oily liquid that can be colorless or can appear amber to black
- Smells like geraniums and could be confused with the smell of ammonia
- Can be vaporized and released into the air, or released into the water or food supply as a liquid

Lewisite Illness

- Exposure occurs by breathing in or ingesting it, or contact with skin or eyes.
- Causes immediate damage to the skin, eyes, and respiratory (breathing) tract.
- Effects are similar to those of arsenic poisoning, including stomach ailments and low blood pressure.
- Signs and symptoms include (all health information was gathered from animal studies, since there are no known cases of human exposure):

Seconds to minutes:

- Skin pain and irritation
- Immediate eye irritation, pain, swelling, and tearing
- Runny nose, sneezing, hoarseness, bloody nose, sinus pain, shortness of breath, and cough

15–30 minutes:

- Skin redness

Within hours:

- Blisters
- Diarrhea, nausea, and vomiting
- Low blood pressure or “lewisite shock”

Within days:

- Blisters form lesions

Within weeks:

- Discoloration of the skin

- Long-term health effects after prolonged exposure or in the case of exposure to high doses:
  - Skin burning
  - Chronic respiratory disease
  - Permanent blindness

Lewisite Diagnosis and Treatment

- Smell of lewisite may signal a release.
- Diagnosis is confirmed from people’s signs and symptoms.
- British-Anti-Lewisite is the preferred antidote and is most effective if given immediately after exposure.
- If swallowed, do not induce vomiting or drink fluids.

BLOOD AGENTS

(Examples: arsine, cyanide)

These agents deprive the blood and organs of oxygen.

ARSINE

Arsine Basic Facts

- Colorless toxic gas
- Has a mild garlic odor that can be detected only at levels greater than those necessary to cause poisoning

Arsine Illness

- Severity of poisoning depends on the amount and duration of exposure.
- Enters the bloodstream and damages red blood cells.
- Exposure to low or moderate doses causes signs and symptoms within 2–24 hours, including:
  - Weakness
  - Fatigue
  - Headache
  - Drowsiness
  - Confusion
  - Shortness of breath
  - Rapid breathing
  - Nausea, vomiting, and/or abdominal pain
  - Red or dark urine
  - Yellow skin and eyes (jaundice)
  - Muscle cramps
- Exposure to high doses can cause:
  - Loss of consciousness
  - Convulsions
  - Paralysis
  - Respiratory failure possibly leading to death
- Long-term side effects of exposure include:
  - Kidney damage
  - Numbness and pain in the extremities
  - Memory loss or confusion

Arsine Diagnosis and Treatment

- Release is confirmed when people start exhibiting signs and symptoms.
- Only during a large release will the garlic odor be prevalent.
- No known antidote.

CYANIDE

Cyanide Basic Facts

- The following four types are most likely to be seen:
  - Hydrogen cyanide
  - Cyanogen chloride
  - Potassium cyanide
  - Sodium cyanide
- In gas form, is colorless and may have a slight almond odor
- Can be released into the air, soil, drinking water, or food supply
- Fast acting
- Evaporates quickly in open areas

Cyanide Illness

- Prevents the body's cells from using oxygen.
- Breathing and ingesting are the most harmful routes of exposure.
- Most harmful to the heart and brain which rely heavily on oxygen.
- Signs and symptoms include:
  - Rapid breathing, restlessness, dizziness, weakness, and headache
  - Nausea, vomiting, and convulsions
  - Loss of consciousness, injury to the lungs, and respiratory failure
  - Permanent heart and brain damage
  - Rapid progression to coma and death

Cyanide Diagnosis and Treatment

- Environmental testing can confirm a release.
- Blood tests can confirm individual exposure.
- Immediate medical attention is recommended.
- Preferred antidotes are a nitrite or a thiosulfate compound.

CHOKING AGENTS

(Examples: ammonia, chlorine, hydrogen chloride, phosgene, phosphine, phosporous [certain forms])

These agents attack the respiratory system, making it difficult to breathe.

CHLORINE

Chlorine Basic Facts

- Used in industry and found in bleach and other common household products.
- Can take a gas form (most likely) or a yellow-green liquid form.
- Emits a strong odor, like bleach, and can become explosive and flammable when mixed with other chemicals.
- Can be released into the air and spreads rapidly.
- Settles close to the ground.
- Liquid form can be released into the water or food supply.

Chlorine Illness

- Signs and symptoms of exposure include:
  - Coughing and tightness in the chest
  - Burning eyes, nose, and throat
  - Blurred vision, nausea, and vomiting
  - Blistered skin
  - Shortness of breath and fluid in the lungs
  - Long-term complications including pneumonia and chronic bronchitis

Chlorine Diagnosis and Treatment

- Air sampling is conducted to confirm a release.
- No known antidote exists.
- Supplemental oxygen should be given as needed.
- Immediate medical treatment is essential.
- If ingested, do not induce vomiting or drink fluids.

PHOSGENE

Phosgene Basic Facts

- Industrial chemical used to make plastics and pesticides.
- Poisonous gas at room temperature that could be released in the air.
- When cooled, is converted into liquid form.
- In a liquid release or spill, changes to gas and stays close to the ground.
- Colorless or a white or pale yellow cloud.
- In low concentrations, smells like newly mown hay.
- In high doses, has a strong unpleasant odor.
- Can cause flammable substances to burn but is not flammable itself.
- Not found naturally in the environment.
- Liquid could be released into food or water.

Phosgene Illness

- In gas or liquid form, can damage the skin, eyes, nose, throat, and lungs.
- Proximity to a release and the length of exposure determine how serious illness is.
- Signs and symptoms may occur immediately after exposure if doses are extremely high. These include:
  - Coughing
  - Burning sensation in the throat and eyes
  - Watery eyes
  - Blurred vision
  - Difficulty breathing or shortness of breath
  - Nausea and vomiting

- With skin contact, possible development of lesions like those from frostbite or burns
- Within 2–6 hours after exposure to high doses, possible development of fluid in the lungs (pulmonary edema)

› Exposure to low or moderate concentrations of phosgene may have few early clinical findings. Development of worsening signs and symptoms may occur 12–24 hours after the initial exposure. Delayed signs and symptoms may surface up to 48 hours after exposure. These include:

- Difficulty breathing
- Coughing up white- to pink-tinged fluid and pulmonary edema
- Low blood pressure
- Heart failure
- Severe respiratory distress

Phosgene Diagnosis and Treatment

› No known antidote.

› Quickly moving away from the source of exposure is most important.

› Supplemental oxygen should be given as needed.

› People should be monitored for up to 48 hours for delayed signs and symptoms.

› Most people exposed recover, but high doses can result in chronic bronchitis and emphysema.

› If ingested, do not induce vomiting or drink fluids.

NERVE AGENTS

(Examples: sarin, soman, tabun, VX)

Affecting the nervous system of victims, these agents are of the greatest concern because of the low amounts needed to produce significant signs and symptoms and even death.

SARIN

Sarin Basic Facts

› Manufactured compound that is colorless, odorless, and tasteless.

› Gas or liquid form and is highly volatile and lethal.

› Absorbed through the skin or respiratory tract and causes severe respiratory damage.

› Even very small amounts can kill people.

› Vaporized sarin stays near the ground.

› Remains deadly in warm, dry temperatures but can degrade in humidity.

Sarin Illness

Signs and symptoms include:

› Difficulty breathing, tightness in chest, and respiratory arrest

› Nausea, drowsiness, vomiting, and diarrhea

› Confusion and seizures

› Drooling, runny nose, eye irritation, and tearing

› Severe muscle weakness

Sarin Diagnosis and Treatment

› With large doses, death can occur within seconds to minutes after exposure.

› Rapid recognition after a suspected attack is the key to successful treatment.

› Atropine and pralidoxime are the preferred antidotes, but must be used quickly to be effective.

› Oxygen should be administered to those having difficulty breathing.

› If ingested, do not induce vomiting or drink fluids.

SOMAN

Soman Basic Facts

› Clear, colorless, tasteless liquid that can smell fruity or like oil of camphor

› Can be heated into a vapor form

Soman Illness

› Can get sick after inhaling or absorbing it through skin or eye contact.

› Can get sick by drinking poisoned water or swimming in contaminated water.

- Can get sick by eating contaminated food.
- Signs and symptoms will appear within a few seconds after exposure to the vapor form.
- In liquid form, produces signs and symptoms within a few minutes or up to 18 hours after exposure.
- Even a tiny drop on the skin can cause sweating and muscle twitching at the site of contact.
- Low or moderate doses cause the following signs and symptoms:
  - Runny nose
  - Watery eyes
  - Small, pinpoint pupils
  - Eye pain
  - Blurred vision
  - Drooling and excessive sweating
  - Cough
  - Chest tightness
  - Rapid breathing
  - Diarrhea
  - Increased urination
  - Confusion
  - Drowsiness
  - Weakness
  - Headache
  - Nausea, vomiting, and/or abdominal pain
  - Slow or fast heart rate
  - Abnormally low or high blood pressure
- Exposure to a large dose may result in these additional health effects:
  - Loss of consciousness
  - Convulsions
  - Paralysis
  - Respiratory failure, possibly leading to death
- Vapors can be trapped on a person's clothing and can expose others.

Soman Diagnosis and Treatment

- Odor may be a signal of a release.
- Treatment with antidotes (atropine and pralidoxime) is recommended as soon as possible (ideally within minutes).
- Long-term supportive health care may be necessary.
- Mild or moderately poisoned people who are treated both rapidly and adequately usually recover completely.
- Severely exposed people or those victims who are ineffectively treated may not survive.
- If ingested, do not induce vomiting or drink fluids.

TABUN

Tabun Basic Facts

- Clear, colorless, tasteless liquid with a faint fruity odor
- Can become a vapor if heated

Tabun Illness

- Can become ill after breathing, ingesting, or through contact with skin or eyes.
- Can get sick by eating contaminated food or water.
- After exposure to vapor form, signs and symptoms should appear within a few seconds.
- Exposure to liquid form produces signs and symptoms within a few minutes or up to 18 hours later.
- Can remain active on a person's clothing, leading to exposure of others.
- A tiny drop on the skin can cause sweating and muscle twitching at the site of contact.
- People exposed to low or moderate doses may experience some or all of the following signs and symptoms within seconds to hours after exposure:
  - Runny nose
  - Watery eyes
  - Small, pinpoint pupils
  - Eye pain
  - Blurred vision
  - Drooling and excessive sweating

- Cough
- Chest tightness
- Rapid breathing
- Diarrhea
- Increased urination
- Confusion
- Drowsiness
- Weakness
- Headache
- Nausea, vomiting, and/or abdominal pain
- Slow or fast heart rate
- Abnormally low or high blood pressure

› Exposure to a large dose may result in:

- Loss of consciousness
- Convulsions
- Paralysis
- Respiratory failure, possibly leading to death

Tabun Diagnosis and Treatment

› Treatment with antidotes (atropine and pralidoxime) is recommended as soon as possible.

› Other supportive health care may be necessary.

› Mild or moderately poisoned people who are treated both rapidly and adequately usually recover completely.

› Severely exposed people or those victims who are ineffectively treated may not survive.

› Repeated exposure can result in long-term damage to the body.

› If ingested, do not induce vomiting or drink fluids.

VX

VX Basic Facts

› VX is an odorless and tasteless amber-colored oily liquid that is very slow to evaporate.

› Can be heated to create a vapor form, but only in small amounts.

› The agent is stable in the environment.

› In average weather, can last on objects for days.

› In extremely cold weather, can sustain its potency for months.

› Can be a long-term hazard on surfaces.

› Considered more toxic than other nerve agents.

VX Illness

› Can ingest it, breathe it in, or come into contact with it through skin or eyes.

› Vapor form can produce signs and symptoms within seconds after exposure.

› In liquid form, produces signs and symptoms within a few minutes or up to 18 hours after exposure.

› Unless washed off immediately, liquid on the skin can be lethal.

› Even a tiny drop on the skin can cause sweating and muscle twitching at the site of contact.

› Remains potent on a person's clothing, meaning that others can be exposed.

› Within seconds or hours of moderate exposure, signs and symptoms include:

- Runny nose
- Watery eyes
- Small, pinpoint pupils
- Eye pain
- Blurred vision
- Drooling and excessive sweating
- Cough
- Chest tightness
- Rapid breathing
- Diarrhea
- Increased urination
- Confusion
- Drowsiness
- Weakness

  - Headache
  - Nausea, vomiting, and/or abdominal pain
  - Slow or fast heart rate
  - Abnormally low or high blood pressure
- Exposure to a large dose may cause:
  - Loss of consciousness
  - Convulsions
  - Paralysis
  - Respiratory failure possibly leading to death

VX Diagnosis and Treatment

- A release may not be easy to detect, because it has no odor.
- A release is confirmed by the signs and symptoms of those exposed.
- Atropine is the preferred antidote and must be given quickly after exposure.
- People can recover completely from mild or moderate poisoning that is both rapidly and effectively treated.
- Those exposed to large doses or those people ineffectively treated may not survive.
- Prolonged exposure can result in long-term damage to the body.
- If ingested, do not induce vomiting or drink fluids.

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