

Recognition and Treatment of Sarin Exposure

Chemical Warfare Agent Identification Fact Sheet Series

The nerve agent sarin (isopropyl methylphosphonofluoridate) is a water-soluble chemical warfare agent (CWA) that is among the most lethal in existence; a single drop can prove deadly. Sarin is an odorless, tasteless, and colorless compound that can be inhaled or absorbed through the skin or eyes, and may be deployed by bombs or in projectiles, including missiles and rockets.

- Sarin is a nerve agent that causes severe disruption to the nervous system and interferes with muscle control and organ function.
- Exposure to even small doses of sarin can be lethal. Damage can occur within one minute of exposure.
- Sarin is odorless, tasteless, and colorless.
- Among the most quickly evaporating nerve agents, sarin is highly reactive and presents an immediate threat.
- The best protection against sarin is to avoid exposure.
- Leave the affected area if possible. If not, attempt to seal off a room by closing ventilation to the outside and sealing spaces under doors and around windows with wet towels to prevent sarin from entering.
- Liquid sarin on the skin can be wiped or blotted off to prevent absorption.
- Sarin is denser than air and settles in low areas near the ground. Seek higher ground in the event of an attack.
- Gas masks will only protect the eyes and lungs. Normal clothes provide little to no protection, as sarin will penetrate clothing and be absorbed across any body surface.
- Do **not** eat food or drink water exposed to sarin.
- Signs and symptoms appear within one minute of exposure:
 - Eye irritation, including pinpoint pupils, blurred vision, pain, excessive tearing
 - Heavy sweating and drooling
 - Respiratory distress, described as a tightness and cough
 - An altered mental status
 - Twitching and seizures

continued

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This CWA Fact Sheet is part of a Physicians for Human Rights (PHR) series designed to fill a gap in knowledge among medical first responders to possible CWA attacks. PHR hopes that, by referencing these fact sheets, medical professionals may be able to correctly diagnose, treat, and document evidence of exposure to CWAs.

Among the most quickly evaporating nerve agents, sarin is highly reactive.

Small pinpoint pupils, a common symptom of exposure to nerve agents, is evident in the eye on the left.



Patients exhibiting these symptoms may have sarin exposure. Other nerve agents can cause similar symptoms. A urine or blood test can determine definitively if someone has been exposed. Hair can sometimes be used, if it has absorbed the agent.

- Decontamination is critically important – for both affected patients and rescuers.
 - Rapid decontamination is key to patient survival.
 - Wear protective clothing, including a respirator, and use heavy rubber gloves for protection. If possible, decontaminate in an area away from where treatment will be given.
 - Decontaminate all protective clothing, respirator, and gloves after exposure to contaminated clothing.
 - Equipment may have to be disposed of in sealed, impermeable plastic bags.
 - Cut off clothes rather than pull them over the head to avoid further exposure to eyes, nose, and throat.
 - Gently wash skin with 10cc bleach per liter of water (saline).
 - If available, use neutralizing preparations such as chloramine solutions or fuller's earth.
- Administer 2 mg atropine every 30 minutes.
- Manage patient airways and suction secretions.

Properties Specific to Sarin

- Easily mixes with water » may be used as poison in water
- Classified as a nerve agent, the most deadly type of CWA
- Among the most quickly evaporating nerve agents; highly reactive and presents an immediate threat
- Odorless, tasteless, and colorless
- Absorbed slowly through the skin and rapidly through inhalation and the eyes
- Breaks down slowly in the body

Properties of All Nerve Agents

- Can be weaponized in a liquid or aerosol form
- Heavier than air and tend to stick to low-lying areas

A urine or blood sample can definitively determine whether a person was exposed to sarin.

Collect Samples to Test for Exposure (applies to all CWAs)

- Collect urine samples, and blood and hair samples if possible, immediately after exposure.
- Collect follow-up samples at 24 hours and 48 hours and again 7 days after exposure.
- Blood and urine can be collected as long as 30 days after exposure and laboratory tests may reveal the presence of sarin or breakdown products.
- Use containers made of unbreakable plastic.
- Affix a means of identifying samples, record date taken, time taken; seal securely.
- Document all symptoms on paper and include with sample; note amount of time it took patients to begin experiencing symptoms after initial exposure.

Urine-specific

- Collect at least 10-30 ml of urine.
- Collect a control urine sample from a person who was not exposed.
- Collect urine in sterile urine cups.
- Ship urine sample with dry ice if possible so that sample is frozen, or at least kept cold.

Blood-specific

- Collect at least and 10-15 ml of blood.
- Keep blood samples cold by placing on ice for as long as possible. Where possible, spin blood to collect plasma. If not possible, allow blood to coagulate and collect serum.
- Cholinesterase testing can detect organophosphate poisoning (this test will detect organophosphates, whereas urine tests can detect more chemical agents).
 - Significantly decreased cholinesterase levels can indicate poisoning.
 - Caution: decreased cholinesterase activity can also result from liver disease and malnutrition.

Hair-specific

- Collect a sample preferably before it has been washed.
- The hair does not need to be collected at the scalp.
- Protection against all nerve agents is the same.

Protection Against Sarin

- Liquid on the skin can be wiped or blotted off to prevent absorption.
- Remain upwind of the affected area if possible.
- Use gas masks to protect eyes and lungs.
- Use full body gear to protect skin (normal clothing offers little protection).
- Clothing can re-emit sarin after being exposed to vapors.
- Attempt to seal off room from contaminated air if unable to exit a contaminated building.
 - Stay in rooms without vents or windows.
 - Turn off ventilation systems if possible.
 - Set ventilation systems to only cycle air inside the building if sarin is released outside.
 - Place wet towels, rags, or other airtight materials along openings under doors or around windows to prevent sarin from seeping in.
- Do not consume food and water that has come into contact with sarin.

Sarin easily mixes with and may be used as a poison in water.

Recognizing Sarin Exposure

- Physical reactions to sarin usually manifest within one minute after exposure – but some people may react sooner.
- Symptoms of low or moderate exposure to nerve agents include:
 - Eye irritation, including pinpoint pupils, blurred vision, pain, excessive tearing
 - Heavy sweating and drooling
 - Respiratory distress, described as a tightness and cough
 - Nausea, abdominal pain, vomiting, lack of bladder and bowel control
 - Altered mental status
 - Unusually low or high blood pressure
 - Unusually slow or fast heart rate
 - Generalized muscle weakness and twitching
- Patients with pinpoint pupils describe having “dim” or “blurred” vision
- Localized muscle twitching and sweating may occur in areas of body exposed to nerve agents
- Symptoms of heavy exposure to nerve agents include:
 - Seizures
 - “Floppy paralysis”
 - Loss of consciousness
 - Respiratory failure leading to death

Differential Diagnosis

- A patient exhibiting the above symptoms has not necessarily been exposed to sarin.
- A urine or blood sample can definitively determine whether a person was exposed to sarin.
- Other nerve agents will cause similar damage to individuals.
 - Other nerve agents will also cause symptoms within seconds / minutes of exposure to vapors, and up to 18 hours after exposure to liquid.
- Patients with neurological conditions such as epilepsy can have seizures.
 - Epilepsy can be worsened by high levels of stress (e.g., conflict zones).
- Distinguish from effects of tear gas
 - Tear gas causes runny nose, respiratory distress, nausea, vomiting, and drooling.
 - Extreme amounts of tear gas can cause respiratory failure.
 - Symptoms are usually temporary and recede within an hour.
 - Tear gas is recognizable by the white plume emitting from the canister.
- Overexposure to some insecticides has the same effect as a nerve agent.

Use atropine injections up to three times every 30 minutes to treat sarin exposure.

Initial Treatment for Nerve Agents

- Initial treatment is the same for all nerve agents.
- Immediately administer an auto-injector antidote of atropine at 2 mg IM and 600 mg of pralidoxime chloride (combi-pens) if available; administering atropine at 2 mg IM is an effective alternative.
 - Use atropine injections up to three times every 30 minutes.

Triage

- Should happen immediately
- Separate contaminated patients into three categories:
 - Contaminated patients who are medically stable
 - Contaminated patients who require immediate stabilization prior to decontamination (patients with life-threatening bleeding, in cardiogenic shock, etc.)
 - Contaminated patients who have life-sustaining medical gear (tourniquet, airway adjunct) that will need to be replaced after decontamination.

Decontamination / Treatment

- Focus on decontamination.
- Start decontamination as soon as possible.
- Decontaminate in an area away from where treatment will be given.
- Wear protective clothing, a respirator, and use heavy butyl rubber gloves for protection over nitrile gloves if possible.
 - If unable to obtain butyl gloves, two layers of nitrile gloves will suffice.
- Start decontamination procedures at the head and end at the toes.
 - Cut off any clothing that would have to go over the head to prevent further contamination.
 - Remove contaminated clothing while taking proper precautions to keep the rescuer safe.
- Use a mixture of with 10cc bleach per liter of water (saline) for decontamination.
- Wash the patient's skin and eyes thoroughly with water or saline solution.
 - Wash the eyes starting from the nose and moving toward the temples.
- Cut off or wash hair after a sample has been collected and stored in a plastic tube.
- After decontaminating patients, rescuers must be decontaminated.
 - Protective clothing, respirator, and gloves will require decontamination after working with contaminated clothing.
 - Equipment may have to be disposed of in sealed, impermeable plastic bags.
- Perform triage on decontaminated patients similarly to a typical mass casualty event.

Follow-Up Treatment for Nerve Agents

- Follow-up treatment for all nerve agents is the same.

Convulsions

- Administer a diazepam (Valium) IV to control convulsions.

Respiratory Failure

- Give patients supplemental oxygen if possible.
- Respiratory failure either due to a CNS issue or hypoxia from bronchial secretions is the main cause of death in nerve agents.
- Routinely monitor patients' airways; suction secretions if necessary.
 - Use normal protocol for suctioning (2-3 seconds with 4-6 second breaks).
- Lay patients on their sides in the recovery position.
- Use an OPA (oropharyngeal airway) to maintain a patient's airway.
- Use an endotracheal tube if there is still high resistance to ventilation.

Physical reactions to sarin usually manifest within one minute of exposure.

Population-Wide Precautionary Measures

- Locate safe, easily sealable rooms in homes and offices.
 - Review with family members and colleagues how to access and exit these rooms in an emergency.
 - Store supplies listed below in these rooms.

Supplies

- Clothes
 - Store extra clothing in airtight containers for safe clothes to wear after decontamination.
- Decontamination materials
 - Store bleach / soap and water in safe, airtight containers.
- Food and water
 - Store food and water in airtight containers.
 - Decontaminate exterior of tin cans or aluminum cans before eating food.
- Cover open water sources such as wells with tarps to prevent contamination.
- Assume that water from aquifers is contaminated until tested.

Abbreviations

CNS – Central Nervous System

IM – Intramuscular

IV – Intravenous

mg – Milligram

ml – Milliliter

OPA – Oropharyngeal Airway

* Information in this fact sheet has been compiled from publicly available sources, including: The Centers for Disease Control and Prevention, Emedicine, Emergency Medical Technician Transition Manual, Federation of American Scientists, Global Security, New York State Department of Health, QANDIL, US Army, and US Occupational Safety and Health Administration.



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