

CBRN Hazards: Pulmonary Irritants

There is no antidote; treatment is supportive.

Agent Overview

Pulmonary irritants are gases that cause respiratory tract injury, including delayed pulmonary edema and Acute Respiratory Distress Syndrome (ARDS).

Agents of concern in the CBRN context include chlorine, phosgene, and diphosgene. Ammonia is included given its widespread industrial availability and potential for mass casualty exposure.

Water solubility determines where in the airway injury occurs and how quickly symptoms appear. Highly soluble agents injure the upper airway and cause immediate symptoms; poorly soluble agents penetrate to the alveoli and may cause minimal early symptoms despite significant exposure.

Agent	Appearance/odour	Solubility	Onset
Ammonia	Colourless gas; sharp pungent odour	High	Immediate
Chlorine	Yellow-green cloud; pungent odour	Intermediate	Immediate with potential delayed progression
Phosgene	Colourless/white cloud; freshly cut hay odour	Low	Delayed up to 24-48 hrs
Diphosgene	Liquid form of phosgene; similar odour	Low	Delayed up to 24-48 hrs

Exposure and Onset

- **Routes of exposure:** Inhalation. Skin and eye injury may occur with direct contact at the source.
- **Onset depends on water solubility:**
 - **High (e.g., ammonia):** immediate symptoms; agent is self-warning; severe exposure may worsen over hours.
 - **Intermediate (e.g., chlorine):** rapid onset; delayed pulmonary edema possible.
 - **Low (e.g., phosgene, diphosgene):** minimal or no early symptoms; pulmonary edema may develop up to 24–48 hrs after exposure.

For intermediate and low solubility agents, delayed pulmonary injury can develop after a symptom-free interval, including in patients with no early symptoms at all.

Clinical Features

- **Respiratory:** cough, dyspnea, bronchospasm, stridor, laryngospasm. Delayed non-cardiogenic pulmonary edema and ARDS.
- **Ocular and dermal:** Ocular - Burning, lacrimation, conjunctivitis, blepharospasm; corneal injury with highly concentrated exposures. Dermal - Erythema and chemical burns; frostbite with direct contact to liquefied or pressurized agents.
- **Serious complications:** Respiratory failure from non-cardiogenic pulmonary edema and ARDS; laryngospasm and upper airway obstruction; cardiovascular collapse in severe cases.

Diagnostic Tests

- Diagnosis is clinical. No confirmatory test is available in the emergency department.
- Investigations are only required in symptomatic patients.
- **Arterial blood gases (ABG) or venous blood gas (VBG):** if respiratory symptoms.
- **Chest x-ray:** obtain if respiratory symptoms present; may be normal early despite significant exposure; repeat if clinical deterioration occurs.

Treatment and Decontamination

- **Contact the Ontario Poison Centre for case-specific clinical guidance: 1-800-268-9017.**
- **Staff protection:** Follow institutional CBRN/HazMat PPE protocols before any patient contact. When treating non-decontaminated patients, wear gloves, gown, eye protection, and a surgical mask at minimum. For decontaminated patients, use universal precautions. Where possible, treat in a well-ventilated area. **Gas exposure is not a significant hazard once the patient is removed from the source.**
- **Patient decontamination (perform first):** Remove all clothing and footwear immediately; double bag and seal. **Beyond clothing removal, skin decontamination is usually unnecessary.** If ocular symptoms, remove contact lenses and irrigate eyes with copious water or saline for 15–20 minutes.
- **Oxygen:** administer for hypoxia; titrate to maintain adequate SpO₂; avoid unnecessary high-flow oxygen.
- **Bronchospasm:** inhaled bronchodilator (salbutamol); corticosteroids can be considered in moderate to severe cases (consult Ontario Poison Centre or respirology).
- **Pulmonary edema/ARDS:** intubation and ventilation per institutional protocol.
- **Chlorine exposure:** Nebulized sodium bicarbonate 2% can be considered in symptomatic patients (consult Ontario Poison Centre).
- **Observation:** Patients with mild exposure should be observed for at least six hours and discharged only if asymptomatic. Those with severe exposure require at least 24 hours of observation. All discharged patients should be instructed to return immediately if respiratory symptoms develop.

This fact sheet is part of a just-in-time resource series for first receivers and was co-authored by Public Health Ontario (PHO) and Ontario Poison Centre (OPC). Contact OPC for 24/7 for clinical guidance: 1-800-268-9017. See the [CBRN Reference List](#) for the full list of references used in these fact sheets.

The information in this document is current as of June 2026.