ORGANOPHOSPHATE/CARBAMATE EXPOSURE - MANAGEMENT

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- Organophosphate (e.g., chlorpyrifos, diazinon, dimethoate, and fenthion) pesticide poisoning is potentially life-threatening and should be managed with urgent risk assessment and advice from expert Toxicologists.
- SCHN staff managing potentially exposed children should seek urgent advice from the Poisons Information Centre (13 11 26) or priority line (02) 7808 3808.
- Chemical identification of a given product can be obtained via the Poisons Information Centre.
- Decontamination should not hinder or delay timely resuscitation, which is paramount if required, and should occur concurrently.
- Organophosphate insecticides do not OFF-GAS and do not cause nosocomial organophosphate poisoning. The smell relates to a hydrocarbon solvent, not the pesticide.
- In-hospital quarantine measures and HAZMAT teams are only required for organophosphate-like chemical weapons.
- Universal precautions with gown, goggles and gloves are sufficient protection when managing poisoned patients.
- If patients smell strongly of solvents, they should be managed in a well-ventilated area and staff should be rotated every 20 mins to minimise hydrocarbon exposure.
- Management involves resuscitation, supportive care and the use of antidotes, in particular potentially large doses of atropine. Oxime therapy is unproven and may cause harm, so is not generally recommended – seek expert advice from a Clinical Toxicologist.
- Chemicals brought to the hospital should be adequately sealed, labelled and disposed in biohazard containers.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
Date Effective:	1st November 2021	**Review Period:** 3 years
Team Leader:	Specialist	**Area/Dept**: Poisons Information

Date of Publishing: 22 October 2021 10:19 AM Date of Printing: 22 October 2021

CHANGE SUMMARY

- Due for review – minor changes made.
- Removed pralidoxime dosing instructions as expert advice should be sought

READ ACKNOWLEDGEMENT

- All clinical staff (medical officers & nurses) working in ED, NETS & PICU should be aware of this document.

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Background

This guideline should be used only in the case of suspected organophosphate (OP; organophosphorus) or carbamate pesticide exposure and does not apply to the situation of exposure to an unknown toxic substance. Organophosphates include but are not limited to chlorpyrifos, diazinon, dimethoate, fenthion, malathion and profenofos. Some common carbamates include carbaryl, mancozeb and methomyl. Chemical identification of a given product can be obtained via the Poisons Information Centre.

Outcome

The safety of all staff, patients and visitors to Sydney Children's Hospital Network is maintained during the acute treatment of a patient with suspected organophosphate exposure.

The person presenting to hospital with suspected OP poisoning will receive timely, efficient and effective health care.

Care Summary

- Clinical toxicology consultation should be sought for ALL patients with organophosphate exposure. SCHN Paediatric Toxicology Services are part of the NSW Poisons Information Centre (PIC). They can be consulted 24/7 by ringing the NSW PIC general number 131126 or through a priority line (02) 7808 3808. Help with chemical identification in a known product is available via NSW PIC.
- All care provided within the Sydney Children's Hospital Network should be in accordance with infection control and manual handling guidelines.
- Resuscitation and treatment in the ED should take place in a well-ventilated area. If the patient smells strongly of hydrocarbon solvent, regular (every 20 minutes) rotation of staff is recommended. Regular rotation of staff may need to continue in ICU/ward if hydrocarbon smell or patient vomiting persists.
- All staff with direct patient contact should observe standard contact precautions for PPE use — gloves, gowns, eye protection and mask.
- Patients with skin exposure should undergo external decontamination as soon as practicable: clothes removed and bagged, skin washed with soap and water. Decontamination should not occur to the detriment of timely resuscitation and medical assessment of the patient.
- Patients with internal exposure (ingestion) should be triaged as Category 1 and moved immediately to the resuscitation area.
- If patient's bodily secretions breach PPE cover, immediately and thoroughly wash the affected area with soap and water.

- The Fire Brigade or HAZMAT services should NOT be called into hospital unless it is a mass casualty (suspected chemical weapon) event or it is advised by a Toxicologist.

Triage

- Treatment needs to be instituted immediately.
- Suspected or confirmed oral ingestion or unstable patients should be triaged immediately as Category 1 to resuscitation area for treatment and concurrent decontamination.
- In the case of dermal/inhalation exposure where the patient is stable at presentation, the patient may be sent to a supervised shower for decontamination.
- Samples of the product brought in with the patient should be placed in sealed bag, clearly labelled with the patient's identification label and marked as “POISON”.
- Senior clinical advice should be sought early by contacting SCHN Paediatric Toxicology Service via NSW Poisons Information Centre on 131126 or priority line (02) 7808 3808.

Decontamination

If skin contamination (either from chemical or vomitus) has occurred:

- Clothing and shoes should be removed and placed in a contaminated waste bag
- Skin - wash with soap and water
- Eyes - flush with copious amounts of sterile 0.9% sodium chloride solution
- Hair - shampoo using copious amounts of soap and water
- Ensure skin folds and underneath of fingernails are cleansed
- All jewellery and accessories should be removed and placed in an appropriately sized sealed bag clearly labelled with the patient's identification label marked as “CONTAMINATED Personal Belongings”
- Soap containing chlorhexidine and alcohol helps remove lipophilic compounds

Nosocomial risk for staff involved in treatment

- There are no toxicologically confirmed case reports of OP poisoning occurring in staff caring for a patient with OP pesticide poisoning.
- OP agents themselves have a very low vapour pressure and are NOT a risk by the inhalation route unless aerosolised.
- The hydrocarbon solvent (e.g. xylene, toluene) in some organophosphate preparations may cause self-limiting symptoms in staff caring for the OP poisoned patient, e.g.

headaches, nausea/vomiting. The hydrocarbon is commonly associated with a noxious odour.

- Staff should be rotated out of the clinical area if they become symptomatic from this exposure. Patients should be cared for in a well-ventilated area of the ED/ICU.
- Isolation of the patient or containment/evacuation of the ED/ICU is NOT required. Fire Brigade or HAZMAT services are not required.

Clinical Pharmacology of Organophosphates

Exposure: Organophosphates are toxic chemicals that may be ingested, inhaled or absorbed (via skin).

Excretion:

- Metabolism is via hydrolysis in the liver.
- Some organophosphates are readily stored in body fat and are released slowly and intermittently, resulting in delayed and prolonged symptoms.

Mode of Action/Response:

- Organophosphates cause irreversible inhibition of the enzyme acetylcholinesterase.
- Carbamates are reversible inhibitors of the enzyme acetylcholinesterase.
- Inhibition of acetylcholinesterase allows the neurotransmitter acetylcholine (ACh) to remain active in the synapse - resulting in sustained depolarisation of the post-synaptic cell (neuron or myocyte) and severe cholinergic toxicity.

Systems Affected:

- Central Nervous System:
  - Delirium, ataxia, depressed motor function, coma and seizures.
- Muscarinic sites in the peripheral nervous system – sustained stimulation of the parasympathetic nervous system causing (DUMBELS):
  - **D**iarrhoea
  - **U**rination
  - **M**iosis, absent pupillary reflex
  - **B**ronchorrhea, bronchospasm, bradycardia with hypotension
  - **E**mesis
  - **L**acrimation
  - **S**alivation, sweating
- Nicotinic sites in the sympathetic and parasympathetic ganglia and nicotinic sites at the neuromuscular junction – these sites are stimulated and then depressed:
  - Tachycardia, hypertension, muscle weakness & paralysis, fasciculations.

Respiratory depression and pulmonary oedema are usually the cause of death without prompt intervention, and the onset can be precipitous.

Symptoms and signs of cholinergic excess

- **Increased Secretions:** tears, saliva, sputum, gastric acid and perspiration.
- **Respiratory:** wheeze, cough, shortness of breath, crepitations, bronchorrhea, decreased respiratory muscle function, ARDS
- **Neurological:** seizure, coma, delirium, respiratory centre depression, fasciculation, ataxia, long-term neuropsychiatric sequelae, depression, and peripheral neuropathy.
- **GIT:** diarrhoea, vomiting, pancreatitis.
- **CVS:** shock, tachy- and brady-arrhythmias, hypo- and hypertension, VT.

Onset of symptoms is usually within 12 hours of exposure (exception: highly fat-soluble OPs such as fenthion).

Severity of Poisoning

Mild	Moderate	Severe
• Alert & ambulant. • Headache, dizzy. • Nausea and vomiting. • Abdominal pain. • Sweating, salivation. • Rhinorrhoea.	• Difficulty walking. • • Muscle twitching (fasciculation) • Weakness. • Anxiety, restlessness. • Small pupils (miosis). • Diarrhoea	• Unconscious, no pupillary reflex. • Seizures. • Flaccid paralysis. • Increased bronchial secretions. • Dyspnoea, crackles/wheeze. • Respiratory failure. • Hypotension

Emergency Department Initial Management

- **Airway:** goal of therapy - airway protection, prevention of aspiration, clearance of secretions and adequate ventilation.
    - If unable to protect airway - intubate and ventilate.

- Muscle relaxants can be used at usual doses with preference for non-depolarising muscle relaxants (e.g. rocuronium). Note: suxamethonium may prolong the block

- **Breathing:** risk of weakness/paralysis of respiratory muscles combined with secretions leading to respiratory failure which can be precipitous. Improve tissue oxygenation with supplemental oxygen and administration of atropine – eliminating hypoxia minimises the risk of ventricular fibrillation.
- **Circulation:** blood pressure may be high or low.
  - Provide blood pressure support as required with inotropes (e.g. noradrenaline) for hypotension not responsive to crystalloid boluses and escalating atropine doses.
- **Deficit:** coma and seizures may occur –
  - Check blood glucose level
  - Treat seizures with benzodiazepines; **do not use phenytoin.** For recurrent seizures seek toxicologist advice.

Laboratory Tests

- **Alert the laboratory that there is a patient with OP poisoning requiring the following tests and the need for rapid processing. Discuss testing with Poisons Information Centre or a Clinical Toxicologist for individual cases**
- Serum cholinesterase activity to confirm exposure - plain (red) tube or heparin (green) tube. This result does not necessarily correlate with severity of poisoning but can be useful in cases of uncertain exposures
- Please note that **cholinesterase levels are not done in SCHN** and staff should ensure expedient delivery of the samples to the appropriate laboratory for urgent results, usually pathology at Royal Prince Alfred hospital.
- ABGs, FBC, BSL, LFTs, lipase and EUC: Metabolic disturbances include hypo/hyperglycaemia, abnormalities of liver function and pancreatitis.
- ECG, CXR, and if the child is old enough, formal spirometry (once secretions have dried up).

NB: Specific antidote treatment (detailed below) should be instituted based on the clinical picture and not on test results

Drug Therapy

Atropine

- Contact pharmacy if supply is limited. Further stock holdings can be accessed on https://www.nswtag.org.au/life-saving-drugs-register/
- Competitively blocks the effects of acetylcholine at muscarinic receptors.

- Early administration of atropine is a treatment priority directed by a toxicologist.
- Loading dose (doubling regimen)
  - Give 0.05 mg/kg (up to 1.2 mg) IV as an initial bolus dose. If end points are not reached after 5 minutes, double the initial dose. Continue to double the dose every 5 minutes until endpoints are reached (or IM, if IV access not available)
  - **Indications:** bradycardia (for age), hypotension, chest secretions or crackles
  - **Endpoints:** HR above lower limit of normal range for age, SBP > 85 + (age x 2) mmHg, and clear chest. Pupillary dilatation is not a reliable sign of adequate therapy. Large doses (up to 100 mg) may be required to reach endpoints.
- Infusion continued once loading dose target end points for atropinisation are reached
  - 6 mg atropine in 60 mL (5 x 1.2 mg ampoules or 10 x 0.6 mg ampoules)
  - Infusion dose: as directed by the Toxicologist; a typical infusion rate would be 10-20% of the total loading dose each hour and reassess hourly for signs of cholinergic excess or atropine toxicity.

Notes:

- Tachycardia is not a contraindication to therapy (it may be secondary to hypoxia or sympathetic stimulation)
- Clinicians should be watchful for signs of over-atropinisation such as delirium, fever and absent bowel sounds; if this occurs, atropine should be ceased, and advice should be sought from a Toxicologist
- Atropine is ineffective against nicotinic effects, such as respiratory depression and muscle weakness
- If crackles are heard on auscultation or there is a return of miosis, bradycardia or sweating, re-establish atropinisation (boluses followed by infusion).

Pralidoxime

- The use of pralidoxime is **not generally recommended *and unproven*.**
- **Discuss the use and dosage of oxime therapy with a Toxicologist prior to institution.**
- Pralidoxime is located at Children's hospital Westmead, Prince of Wales and Westmead hospitals.
- Confirm with toxicologist if cholinesterase levels are required prior to pralidoxime therapy.
- Rapid administration may result in tachycardia, laryngeal spasm, muscle rigidity and transient neuromuscular blockade with weakness.
- **Do not use oximes in carbamate poisoning** (e.g. methomyl).
- **Pralidoxime iodide is contraindicated in patients with iodine allergy.**

Drug Precautions

OP poisoning can cause prolonged or exaggerated effects of certain drugs including barbiturates, morphine, theophylline, phenothiazines, and suxamethonium.

Monitoring and Observation

- Observations should include continuous ECG and SpO2 monitoring. Non-invasive blood pressure (NIBP) readings should be taken every 5 to 15 minutes depending on the patient's status.
- The patient may require intra-arterial BP and CVP monitoring if more severely poisoned.
- Observe for deterioration post reduction of drug dose, auscultate lung bases for crackles.

Transfer from ED

- The patient should be admitted under the care of a General Paediatrician and/or Toxicologist (as per local arrangements). Children over 15 years of age should be discussed with the Toxicology unit of the associated adult hospital (e.g. Westmead Hospital, POWH) where it might be more appropriate for them to be managed.
- The patient should be admitted to a monitored bed in a Close Observation Unit or to the Paediatric Intensive Care Unit.
- There is no need for isolation of the patient due to OP poisoning. However, if there is a strong hydrocarbon odour, it is appropriate to manage the patient in a single room with good ventilation and have regular staff rotation until the odour resolves.
- Where deliberate self-poisoning is suspected, ensure psychiatric referral is arranged for when the patient is able to communicate sufficiently to be assessed.
- The area in which the patient was treated should be cleaned with dilute hypochlorite (bleach) solution.

Disposal of Poison and Clothing Items

- If the OP agent is brought to the ED, the item should be placed in an appropriately sized and sealed bag and clearly labelled with the patient's identification label and be marked as "POISON".
- The patient's clothing, jewellery and all leather items (leather readily absorbs pesticides) are to be placed in a sealed bag, clearly labelled with the patient's identification label and marked as "CONTAMINATED Personal Belongings".

- The OP container and patient belongings are retained within the ED until such time as they are no longer required for forensic examination, as per the Emergency Physician or Toxicologist (and police investigators, where indicated).
- Unless required for forensic purposes, clothing and jewellery may be returned to patient for thorough cleansing however leather items should be disposed of in contaminated waste.
- Next of kin are to be informed of the necessity for the disposal of leather items and this is to be documented in the health care record.

Transport of organophosphate-exposed patients

- Patients transported by ambulance, helicopter or fixed-wing aircraft should have the cabin space as well ventilated as is practical as confined spaces will increase the exposure of staff to hydrocarbon fumes. If significant exposure is anticipated, then the journey may have to be broken up into stages with rotation of staff or a period spent in a better ventilated area.
- If possible, the chemical agent of interest may be transported with the patient for identification purposes; in this case, the agent should be sealed and labelled.
- Following transport, the cabin should be cleaned with dilute hypochlorite (bleach) solution.

References

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Appendix 1: Glossary of Terms

ABGs	Arterial blood gases
ARDS	Acute Respiratory Distress Syndrome
BSL	Blood sugar/glucose level
CVP	Central venous pressure
CXR	Chest X-ray
ECG	Electrocardiogram
ED	Emergency Department
EUC	Electrolytes and renal function tests
FBC	Full blood count
ICU	Intensive Care Unit
LFTs	Liver function tests
NETS	Newborn & Paediatric Emergency Transport Service
NIBP	Non-invasive blood pressure
OP	Organophosphate insecticide
PICU	Paediatric Intensive Care Unit
VT	Ventricular tachycardia

Appendix 2: Initial Emergency Management of Organophosphate or Carbamate Poisoning

General

Ensure well-ventilated area.

Wear PPE for standard contact precautions.

Bag & seal clothes & jewellery.

Decontaminate with soap & water concurrent to resuscitation/treatment)

Attach monitoring

Resuscitate

A – Intubate if airway not protected
– Use non-depolarising muscle relaxant. [2]
B – Give supplemental oxygen
C – Fluids ± inotropes for hypotension
D – Benzodiazepines (not phenytoin) for seizures

Reassess regularly

Atropine IV

Load with doubling doses every 5 min until end points. [1]
Commence atropine infusion. [3]

Investigations

Blood: Serum and red cell cholinesterase levels as directed by a toxicologist,
ABG, FBC, EUC, LFTs, lipase.
ECG
CXR

Other Therapy

Discuss need for pralidoxime or other therapy with a Toxicologist via Poisons Information Centre (131126)

Notes

1. Preferably use non-depolarising agent (e.g. rocuronium or vecuronium) but may need to increase dose. If using suxamethonium reduce dose.
2. Start atropine with 0.05 mg/kg (max 1.2 mg), then double dose every 5 min until HR in normal range for age, SBP > 85 + (age x 2) mmHg and chest is clear.
3. Start atropine infusion at 10-20% of total loading dose/hr. Watch for atropine toxicity.