ORGANOPHOSPHATE EXPOSURE: MANAGEMENT

PRACTICE GUIDELINE ©

DOCUMENT SUMMARY/KEY POINTS

- Organophosphate poisoning is potentially life-threatening and should be managed with urgent risk assessment and advice from expert Toxicologists.
- SCHN staff managing exposed children should seek urgent advice from their local Toxicology service or the NSW Poisons Information Centre (13 11 26).
- Resuscitation of the patient, if required, is paramount and should occur concurrently with decontamination; i.e. decontamination should not hinder or delay timely resuscitation.
- Organophosphate insecticides do not OFF-GAS and do not cause nosocomial organophosphate poisoning.
- SCHN staff should contact the NSW Poisons Information Centre prior to instituting any quarantine measures or contacting HAZMAT teams.
- Universal precautions with gown, goggles and gloves should be observed when managing poisoned patients.
- The patient should be managed in a well-ventilated area and staff should be rotated every 20mins to minimise hydrocarbon exposure.
- Management involves resuscitation, supportive care and the use of antidotes including atropine (in a doubling regimen). Oxime therapy is controversial and unproven – seek expert advice.
- Chemicals brought to the hospital should be adequately sealed, labelled and disposed in biohazard containers.

Approved by:	SCHN Policy, Procedure and Guideline Committee	
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Team Leader:	Medical Director	**Area/Dept**: Poisons Information Centre

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CHANGE SUMMARY

- Due for review – no changes made.

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 known organophosphate (OP) or carbamate exposure and does not apply to the situation of exposure to an unknown toxic substance.

Outcome

The safety of all staff, patients and visitors to the Health Service is maintained during the acute treatment of a patient with known organophosphate exposure.

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

Policy Statement

- All care provided within the Sydney Children's Hospital Network should be in accordance with infection control and manual handling guidelines.
- Resuscitation and further treatment in the ED should ideally take place in a well-ventilated area with regular (every 20-minutes) rotation of staff. Regular rotation of staff may need to continue in ICU/ward if hydrocarbon smell or vomiting persists.
- All staff with direct patient contact should observe standard precautions — gloves, gowns, eye protection and normal mask (where required).
- Patients with skin exposure should undergo external decontamination as soon as practicable: clothes removed and bagged, and the person 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 (inhalation/ingestion) should be triaged and moved immediately to the resuscitation area for initial assessment and management.
- Staff in direct contact with patient's bodily secretions should immediately and thoroughly wash the affected area with soap and water.
- Treating medical staff should seek expert advice from Toxicologists locally or at the **NSW Poisons Information Centre** (13 11 26) at the earliest opportunity. In particular, the Fire Brigade or HAZMAT services should NOT be called into hospital until speaking to a Toxicologist.

Triage Process

Treatment is to be instituted immediately based upon the clinical picture of organophosphate poisoning.

- In all oral ingestions or any unstable patients, triage immediately 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 with the patient should be placed in sealed bag, clearly labelled with the patient's identification label and be clearly marked as “POISON”.
- Senior clinical advice should be sought early by the use of local clinical expertise (where available). An alternate source of clinical expertise and advice is the Poisons Information Centre on 13 11 26: an on call clinical toxicologist is available 24hours, 7 days a week.

Decontamination Advice

If the person has skin contamination (either from chemical or vomitus), then the person’s clothes should be removed and placed in a contaminated waste bag and the person washed with soap and water.

- **Skin** - contamination of skin, clothing, hair, eyes.
  - Flush the chemical from the eyes with copious amounts of sterile 0.9% sodium chloride solution.
  - Remove clothing and wash patient and shampoo hair, using copious amounts of soap and water.
  - Ensure skin folds and underneath of fingernails are cleansed.
  - Contaminated leather articles should be removed (including watch bands) and placed with the patient's clothing in an appropriately sized and sealed bag and clearly labelled with the patient's identification label and be clearly marked as “Contaminated Personal Belongings”.
- **Soap** containing chlorhexidine and alcohol helps remove lipophilic compounds.
- In OP ingestion, there may be contamination from spillage or vomitus requiring local decontamination.

Nosocomial risk for staff involved in treatment

- There are no case reports of OP poisoning occurring in staff caring for a patient with OP poisoning.
- OP agents do NOT off-gas and cause poisoning in treating health care staff
- However, the hydrocarbon solvent (not the organophosphate compound) associated with OPs 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 usually required and should not be called until speaking to a Toxicologist.

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 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).

Systems Affected:

1. Central Nervous System:

   Delirium, ataxia, depressed motor function, coma and seizures.

2. Muscarinic sites in the peripheral nervous system:

   Sustained stimulation of the parasympathetic nervous system causing (DUMBELS):

   - Diarrhoea
   - Urination
   - Miosis, absent pupillary reflex

- Bronchorrhoea, bronchospasm, bradycardia
- Emesis
- Lacrimation
- Salivation, sweating

3. Nicotinic sites in the sympathetic and parasympathetic ganglia and nicotinic sites at the neuromuscular junction – these sites are stimulated and then depressed:
   - Hyperthermia, hypotension, muscle weakness & paralysis, fasciculations.

Respiratory depression and pulmonary oedema are the usual causes of death without prompt intervention.

Symptoms and signs of cholinergic excess

- **Secretions:** tears, saliva, sputum, gastric acid and perspiration.
- **Respiratory symptoms:** wheeze, cough, shortness of breath, bronchorrhoea, decreased respiratory muscle function, ARDS
- **Neurological symptoms:** 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, VT.
- Onset of symptoms is usually within 12 hours of exposure (exception: highly fat-soluble OP esters).

Grading of Severity of Poisoning

Mild	Moderate	Severe
• Alert & ambulant. • Headache, dizzy. • Nausea and vomiting. • Abdominal pain. • Sweating, salivation. • Rhinorrhoea.	• Cannot walk. • Soft voice. • Muscle twitching. (fasciculation) • Weakness. • Anxiety, restlessness. • Small pupils (miosis).	• Unconscious, no pupillary reflex. • Seizures. • Flaccid paralysis. • Increased bronchial secretions. • Dyspnoea, crackles/wheeze. • Respiratory failure.
Plasma cholinesterase ~20-50% of normal.	Plasma cholinesterase ~10-20% of normal.	Plasma cholinesterase <10% of normal.

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.
  - If using non-depolarising muscle relaxants, there may be delayed onset with higher dosage required to obtain the desired effect; non-depolarising agents are preferable as they may be protective against neuromuscular junction degradation
  - If using suxamethonium, reduce the dose as there may be prolonged muscle paralysis due to plasma cholinesterase blockade; Note: Suxamethonium is NOT contraindicated in OP poisoning.
- **Breathing:** risk of weakness/paralysis of respiratory muscles combined with secretions leading to respiratory failure. 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) hypotension not responsive to crystalloid boluses.
- **Deficit:** seizures may occur –
  - Check blood glucose level
  - Treat seizures with diazepam; **do not use phenytoin**

Laboratory Tests

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

- **Alert the laboratory to the fact you will be requesting these tests to assist in rapid processing**.
- Plasma cholinesterase to confirm exposure - plain (red) tube or heparin (green) tube.
- Red cell cholinesterase for persistence of esterase inhibition – heparin (green) or EDTA (purple) tube.
- Please note that c**holinesterase levels are not done in SCHN** and staff should ensure expedient delivery of the samples to the appropriate laboratory for urgent results.
- ABGs, FBC, BSL, LFTs, lipase and EUC: Metabolic disturbances include hypo/hyperglycaemia, abnormalities of liver function and pancreatitis.
- ECG, CXR and formal spirometry (once secretions have dried up).

Drug Therapy

Atropine

- Competitively blocks the effects of acetylcholine at muscarinic receptors.
- Loading dose (doubling regimen)
  - Give 0.05mg/kg (up to 3mg) 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 end-points are reached. (or IM if IV access not available)
  - **Indications:** bradycardia (for age), hypotension, chest secretions or crackles
  - **End-points:** 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 100mg) may be required to reach end-points.
- Infusion (~10-20% of total loading dose per hour)
  - 6mg atropine in 60mL (5 x 1.2mg ampoules)
  - Infusion dose: give 10-20% of the total loading dose each hour

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 (may require an atropine infusion).

Pralidoxime

- Pralidoxime belongs to a group of agents called “oximes”
- Regenerates acetylcholinesterase and acts synergistically with atropine; use of pralidoxime is ***controversial and unproven***.
- **Discuss the use of oxime therapy with a Toxicologist prior to institution**
- Before administering, ensure blood specimen (heparinised tube) is taken for cholinesterase levels.
- Rapid administration may result in tachycardia, laryngeal spasm, muscle rigidity and transient neuromuscular blockade.
- Pralidoxime is used in moderate/severe poisoning with impaired respiratory function or seizures/coma.

- **Do not use oximes in carbamate poisoning** (e.g. methomyl).
- Delayed presentation of a symptomatic patient is not a contraindication to the use of pralidoxime.
- Pralidoxime iodide, the only form currently available in Australia, is 1g pralidoxime chloride is ≈ 1.5g pralidoxime iodide. **Pralidoxime iodide** dosing (N.B. pralidoxime iodide ampoules are available as 500mg in 20mL):
  - Bolus: 30mg/kg (maximum 2g) as a neat 2.5% solution over 30 minutes.
  - Infusion:
    - 500mg in 100mL 0.9% sodium chloride (5mg/mL)
    - Infusion dose: 10mg/kg/hr IV (maximum 500mg/hr), for 12-24 hours.
  - Pralidoxime dose should be reduced in renal impairment.
  - **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, reserpine, suxamethonium.

Monitoring and Observation

- Observations should include continuous ECG, NIBP and SpO_2 monitoring.
- The patient may require intra-arterial BP and CVP monitoring if more severely poisoned.
- Observe for deterioration post reduction of drug therapies, auscultate lung bases for crackles.

Transfer from ED

- The patient should be admitted under the care of a Toxicologist or Physician (as per local arrangements). Children over 15 years of age should preferentially be managed at the Toxicology unit of the associated adult hospital (e.g. Westmead Hospital, POWH)
- Admit to a monitored bed in a high dependency unit or to the 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 may be appropriate to manage the patient in a single room with adequate ventilation and regular staff rotation until complete decontamination has occurred
- Where deliberate self-poisoning is suspected, ensure psychiatric referral is made at an appropriate time.
- The ED bay is to 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 clearly marked as “Poison”.
- The patient's clothing and all leather items (watch band, necklaces, shoes etc) are to be placed in a sealed bag and clearly labelled with the patient's identification label and clearly 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).
- When there is no need for the clothing/leather to be given over for Police investigation or is not required, the clothing and leather is to be disposed of in general waste.
- Next of kin are to be informed of the necessity for the disposal of clothing items and this is to be documented in the health care record.

Transport of Organophosphate-exposed patients

- Patients transported by ambulance or NETS should be placed in well-ventilated cabins, (van or helicopter); transporting staff may be exposed to hydrocarbon fumes in a confined space and should be rotated out of the cabin if at all possible
- 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.

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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**