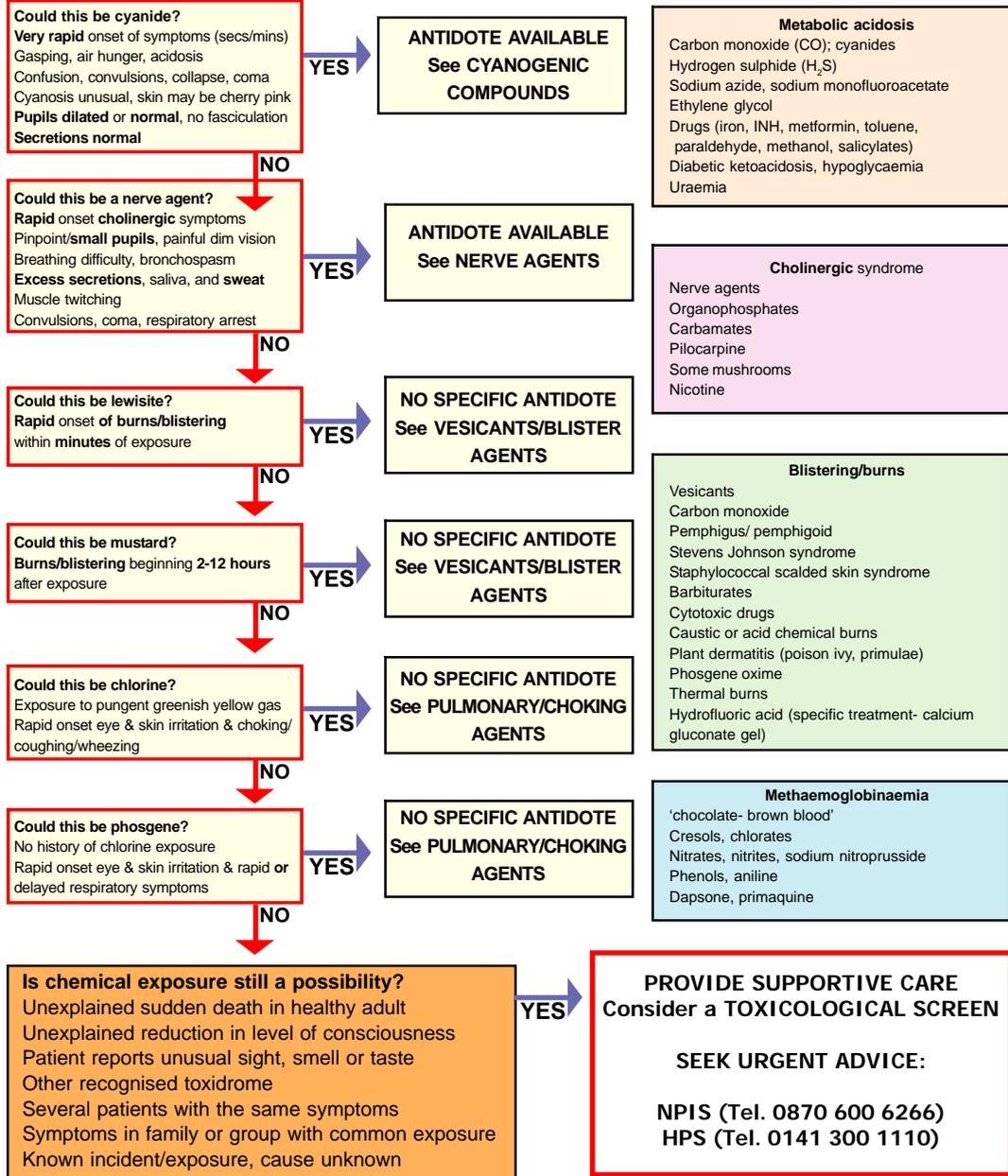


# RECOGNITION & EARLY MANAGEMENT OF CHEMICAL EXPOSURES

## BE ALERT TO THE POSSIBILITY OF CHEMICAL EXPOSURE – IF YOU SUSPECT IT:

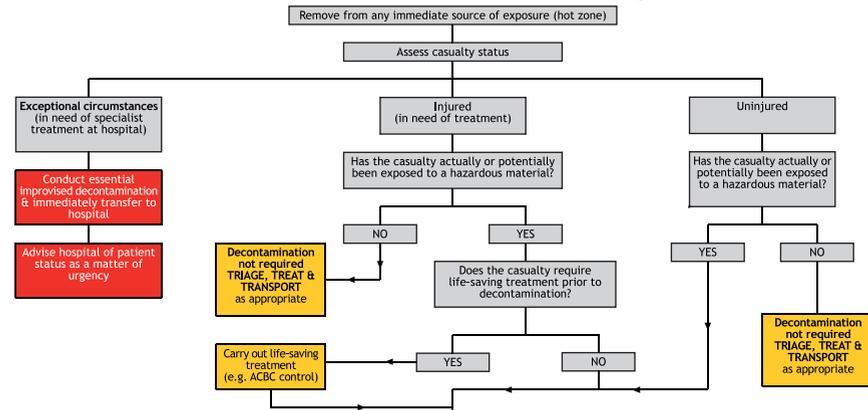
Protect yourself - ensure that you are wearing PPE – do not attempt mouth-to-mouth resuscitation  
 Decontaminate the patient – prompt decontamination may be life saving, and may be the only form of treatment  
 Stabilise airway (85% oxygen by mask, intubate and ventilate if needed), control any haemorrhage, set up IV access  
 Assess cause, administer antidotal treatment if appropriate, reassess, and seek expert advice early.



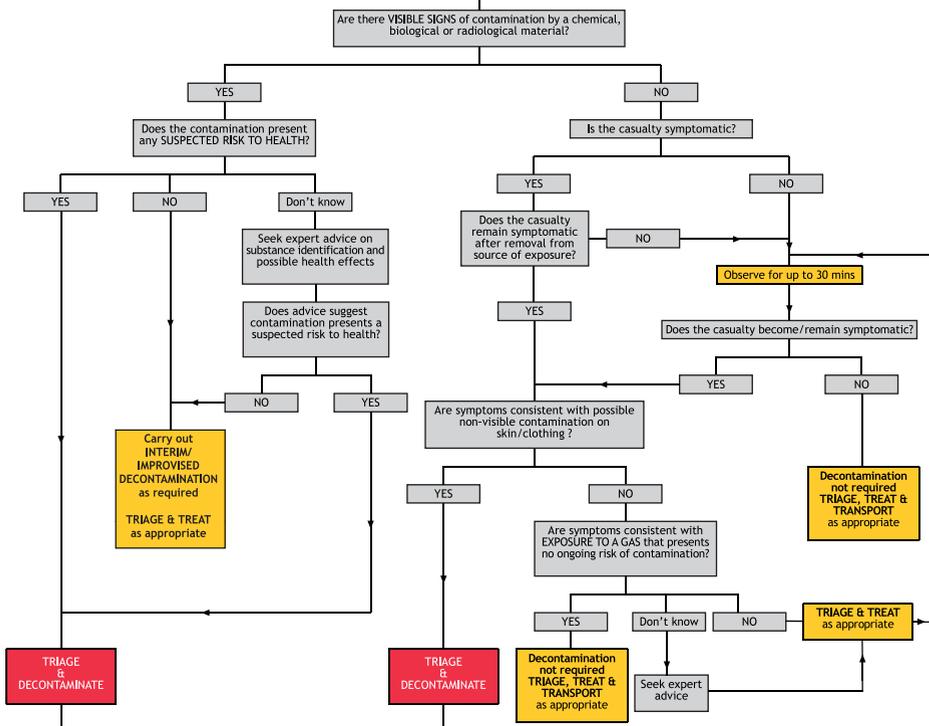
Agents & Exposure Routes	Signs & Symptoms	Onset	Laboratory/ Diagnostic tests	Treatment	Differential diagnosis
<p><b>Cyanogenic compounds:</b>  <b>Hydrogen cyanide (AC)</b>  <b>Cyanogen chloride (CK)</b>  <b>Cyanide salts</b>  <b>Inhalation, ingestion or dermal absorption</b>                      Interferes with cellular aerobic respiration à tissue anoxia</p>	<p><b>Moderate exposure:</b> Palpitations, dizziness, nausea, vomiting, headache, eye irritation, hyperventilation, drowsiness, hallucination.                      Venous blood O<sub>2</sub> level above normal, hypotension, cyanosis but skin usually remains 'pink' in colour.  <b>High exposure:</b> Immediate loss of consciousness fixed and dilated pupils, convulsions, cardiac arrhythmia, pulmonary oedema, and possibly death within 1 to 15 minutes.                      Absence of respiratory irritation from hydrogen cyanide gas.                      Liquid cyanogen chloride can cause chemical burns and irritation of eyes/respiratory tract.</p>	<p>Rapid onset (seconds)                      Cyanide is detoxified by the body at a rate of ~17 mg/kg min.</p>	<p>Cyanide (whole blood) or thiocyanate (serum) – take sample before antidote given.                      Blood CN concentrations:                      &lt;2 mg/l @ mild poisoning                      2-3 mg/l @ moderate poisoning                      3-4 mg/l @ severe poisoning                      Elevated plasma lactic acid.</p>	<p>Remove patient from source of exposure. Many patients will recover even without specific antidotal therapy if vigorous supportive care is provided.                      If decontamination is required, remove the patient's clothing and wash the skin with dilute detergent and water.                      Ventilatory support: 100% oxygen by facemask and bag with non-return valve; intubation with 100% O<sub>2</sub> if indicated.                      Metabolic acidosis may need correction with IV bicarbonate, and seizures may need to be treated with diazepam.  <b>Antidotes:</b> sodium thiosulphate &amp; sodium nitrite, <b>OR</b> dicobalt edetate.  <b>Sodium thiosulfate / nitrite combination</b> (order is unimportant):                      Dose: Adult: 25 ml of 50% <b>sodium thiosulfate</b> solution IV over 10 min. Child: 400 mg/kg IV. (Note this is higher than the equivalent adult dose).                      Adult: 10 ml of 3% <b>sodium nitrite</b> IV over 5-20 min. Child: 4-10 mg/kg.  <b>Dicobalt edetate:</b> If considering dicobalt edetate, equipment for emergency endotracheal intubation must be immediately available. Confirmation of cyanide poisoning is important prior to using dicobalt edetate, as its use may induce severe hypotension in the absence of cyanide.                      Dose: Adult: 300mg IV over 1 min followed by 50 ml of 50% dextrose.                      Child: 4 mg/kg over 1 min followed immediately by 25ml (if &lt;2 yrs) or 50ml (if &gt; 2 yrs) of dextrose IV infusion 25%.</p>	<p><b>Carbon monoxide</b>                      (Possible elevated CO-Hb levels)  <b>Hydrogen sulphide</b>                      (Possible rotten eggs odour)  <b>Nerve agents</b>                      To distinguish: pupils constricted, muscle fasciculations.</p>
<p><b>Organo-phosphates / Nerve Agents:</b>  <b>Sarin (GB)</b>  <b>Tabun (GA)</b>  <b>Soman (GD)</b>  <b>GF</b>  <b>VX</b>  <b>Inhalation, dermal &amp; ocular absorption, ingestion</b>                      Nerve agents act by cholinesterase inhibition</p>	<p><b>Moderate exposure:</b> Nausea, diarrhoea, diffuse muscle cramping, runny nose, salivation, difficulty breathing, eye pain, pinpoint pupils (miosis), dimming and blurring of vision, sweating, muscle tremor and weakness, incontinence (urinary &amp; faecal), and confusion.  <b>High exposure:</b> The above plus bronchorrhoea, sudden loss of consciousness, seizures, cardiac arrhythmias, flaccid paralysis (late sign).                      Localised exposure (by absorption) gives localised symptoms (fasciculations, sweating).                      Respiratory failure is the major cause of death, can occur within minutes.</p>	<p><b>Inhalation of vapour:</b>                      Seconds to minutes  <b>Absorption / ingestion of liquids:</b>                      Minutes to hours</p>	<p>RBC cholinesterase or serum cholinesterase – take sample before any oxime antidotes are given.                      Blood gases to monitor respiratory function &amp; acid-base balance.                      ECG - nerve agent toxicity has been associated with QT interval prolongation, PR prolongation, and torsade de pointes.</p>	<p>IMMEDIATE decontamination: <b>Remove patient from the source of exposure; remove and bag contaminated clothing; decontaminate skin with dilute detergent and copious amounts of water (use of a 0.5% hypochlorite solution with copious amounts of water is suggested in E-Medicine for chemical deactivation of nerve agents).</b>  <b>Ventilatory support:</b> high dose oxygen.                      ECG monitoring in severe cases.  <b>Atropine sulphate:</b> for hypersecretion, bradycardia or pulmonary oedema.                      Dose: Adult: 0.6-2.0 mg, IV. Child: 20-40 µg/kg, IV.                      Repeat every 10-30 mins until secretions are minimal and the patient is atropinised (dry skin &amp; sinus tachycardia).                      In severe cases of adult poisoning, a 2 mg dose may be repeated every 3-5 mins as needed.  <b>Pralidoxime mesylate:</b> for muscle weakness, fasciculations, severe toxicity. (Refer to TOXBASE for availability in Scotland)                      Dose: 30 mg/kg body weight for adults and children (2 g in adult), IV over 4min (30 mg/kg IV every 4 - 6hrs in severe cases).                      Early administration is a priority.                      Additionally in severe cases, an infusion of 8-10 mg/kg/hr may be administered.  <b>Diazepam:</b> for seizures and agitation                      Dose: Adult: 10 mg, IV. Child: 0.1-0.3 mg/kg, IV.</p>	<p><b>Organophosphate or carbamate pesticides</b>  <b>Cyanide</b>                      To distinguish - pupils normal or dilated; no increased secretions; possible almond odour.                      Myasthenia gravis</p>
<p>Vesicants / Blister agents:                      Sulfur mustard (H, HD)                      Lewisite (L)                      Phosgene oxime (CX)</p> <p>Inhalation and dermal absorption</p>	<p><b>Moderate exposure:</b> Conjunctivitis, limited erythema, cough, sore throat, watery/painful swollen eyes (eyes are most susceptible – effects even at very low concentrations)  <b>Moderate to severe exposure:</b> Nausea and vomiting (early symptoms), burning, itching or red skin, blisters*, mucosal irritation (prominent tearing), sore throat, rhinorrhoea, severe conjunctivitis, corneal damage and lid swelling, photophobia. Shortness of breath, dry cough, ARDS, bronchopneumonia.                      *Blisters: Delayed appearance; painless → H or HD exposure. Immediate appearance; painful → L or CX exposure.                      Cardiac arrhythmias, neutropaenia and sepsis (late in course)                      In severe cases, delayed necrotic sloughing of upper airways with haemorrhagic pulmonary oedema may be seen.</p>	<p>Sulfur mustard: delayed onset - hours to days, dependent upon exposure.                      Lewisite &amp; phosgene oxime: rapid onset</p>	<p>Urine thiodiglycol (metabolite of sulfur mustard).                      Leukocytosis on first day, with maximal effect after ~2 weeks following exposure. A leukocyte count of 500 or less is suggestive of an unfavourable prognosis.                      Monitor WBC count in severe cases as bone marrow depression can occur.                      ECG – Lewisite toxicity has been associated with QT interval prolongation and T-wave changes.</p>	<p>IMMEDIATE decontamination: Remove the patient from the source of exposure; remove and bag all contaminated clothing; wash patient's eyes with 0.9% saline; wash skin with copious amounts of dilute detergent and water (the use of a 0.5% hypochlorite solution with copious amounts of water is suggested in DoH Guidelines, and in E-Medicine for the deactivation of mustard agents when the patient's skin is not erythematous).  <b>No antidotes available, however sulfur donors (e.g. thiosulfate) may decrease systemic effects when given within 20 mins of exposure. Chelation therapy may be indicated for LEWISITE exposure (seek specialist advice prior to commencing such therapy).</b>                      Treat blisters as burns and consider using topical antibiotics to prevent secondary infection.                      Patients may require simple symptomatic care through to complex management commensurate with burns, immunosuppression and multi-system involvement.</p>	<p>Diffuse skin exposure with <b>caustic irritants</b> such as sodium hydroxides, ammonia etc may cause similar syndromes.                      Onset of symptoms likely to be more rapid.</p>
<p>Pulmonary / choking agents:  <b>Phosgene (CG)</b>  <b>Chlorine (CL)</b>                      Inhalation                      Greater water solubility of agent &amp; decomposition into HCl = greater mucosal irritation.                      Clinical effects therefore depend on solubility of agent</p>	<p>Mucosal and dermal irritation &amp; redness, nausea &amp; vomiting shortness of breath, pulmonary oedema (after a latent period of up to 24hrs), cough, chest tightness, wheezing, laryngeal spasm, rales, haemoptysis.                      Phosgene effects can have 3 phases –                      -Initial irritation of eyes, nausea &amp; vomiting, chest tightness                      -Latent phase (asymptomatic period)                      -Oedema phase (as above), lower respiratory tract symptoms                      Chlorine symptoms start earlier, more mucosal irritation, symptoms associated more with upper respiratory tract. Cyanosis may be observed particularly during exertion.</p>	<p>1-24hrs (or rarely up to 72hrs)                      May be an asymptomatic period of hours.</p>	<p>No specific tests available but history may help identify source and exposure characteristics.                      Elevated lactate dehydrogenase is consistent with serious phosgene inhalation.                      ABGs, pulmonary function tests.                      Chest x-rays (serial for phosgene).</p>	<p>Remove the patient from the source of exposure.                      Provide supplemental oxygen (humidified if possible), as required, by nasal cannula, face mask, non-rebreather mask, non-invasive positive pressure ventilation, or intubation.                      Poor oxygenation or laryngospasm may necessitate intubation.                      Positive pressure ventilation with positive end-expiratory pressure (PEEP) may improve oxygenation in patients with non-cardiogenic pulmonary oedema.                      Supportive care – maintain airway, use bronchodilators for bronchospasm.  <b>No antidotes available.</b> however intratracheal N-acetylcysteine may confer some protection against phosgene-induced lung injury by maintaining protective levels of glutathione.                      Treatment symptomatic and supportive.                      Consider high dose corticosteroids to prevent pulmonary oedema (role unproven).                      Consider antibiotics if pneumonia develops.</p>	<p>Smoke inhalation, pneumonia.</p>
<p><b>Ricin</b>  <b>Ingestion or inhalation</b>                      Inhaled ricin affects lung directly.                      Poorly absorbed by ingestion</p>	<p><b>Ingestion:</b> Nausea, bloody diarrhoea, vomiting, abdominal pain, GI irritation &amp; inflammation, fever, hepatic, splenic and renal necrosis, seizures.                      Possible constricted pupils and tachycardia.                      If severe exposure, death from multi-organ failure or respiratory collapse can occur.  <b>Inhalation:</b> Nausea, fever, chest tightness, coughing, weakness. Followed by profuse sweating, pulmonary oedema, cyanosis, hypotension, respiratory failure, and circulatory collapse.                      Death within 36-72hrs.                      Powder is extremely irritating to the eyes.</p>	<p>Onset of symptoms may be delayed following ANY route of exposure.                      Aerosol exposure causes weakness, fever, cough, and pulmonary oedema within 18-24 hours and severe respiratory distress and death within 36-72 hours.</p>	<p>FBC, Us &amp; Es, creatinine, glucose, liver function tests, INR.                      Chest x-rays.                      ELISA (currently in development) on serum, respiratory secretions and tissue may be useful.</p>	<p>If decontamination is required, remove patient's clothes and clean the skin with dilute detergent and water.                      (The use of a 0.5% hypochlorite solution with copious amounts of water is suggested in E-Medicine for deactivation of ricin: use a 0.5% sodium hypochlorite solution with a contact time of 15 minutes. Do not instill this solution into open abdominal, brain, or spinal cord injuries or into the eyes. It can be instilled into non-cavity wounds and then removed via suction into disposable containers. This discarded solution is neutralized and non-hazardous in 5 minutes. In the absence of this solution, the use of copious amounts of soap and water is recommended.)  <b>No antidotes available.</b>                      Supportive care – maintain airway, bronchodilators for bronchospasm, treat severe pulmonary oedema with PEEP.                      For ingestion consider charcoal lavage (50g for adults, 15g for children).</p>	<p><b>Tularaemia, plague, anthrax, staphylococcal enterotoxin B , and Q-fever</b> may cause similar syndromes.                      Phosgene</p>

# Scottish CBRN & Hazmat Decontamination Algorithm (SCHDA)

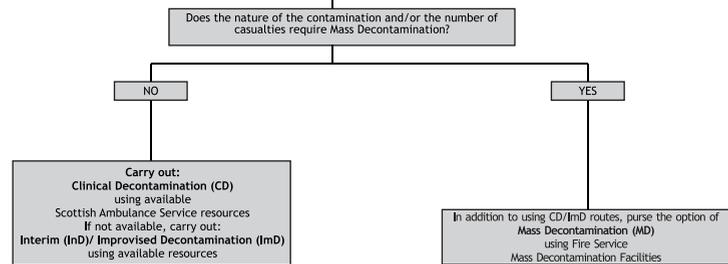
INJURY & EXPOSURE ASSESSMENT



DECONTAMINATION ASSESSMENT



DECONTAMINATION TECHNIQUES



If a patient presents with an unusual or unexplained illness it is essential that further appropriate specialist clinical advice is sought regarding the diagnosis AND The Public Health Department at your local NHS Board is notified to investigate whether the patient has been exposed to an agent, which is causing the illness.

For further specialist advice contact:

**Health Protection Scotland (HPS)**



Tel: 0141 300 1100 or 'out of hours' 0141 211 3600

and

The Consultant in Public Health Medicine (CPHM) at your local NHS board

## NHS boards

HPS	Tel: 0141 300 1100	out of hours 0141 211 3600
Ayrshire and Arran	Tel: 01292 885 876	out of hours 01563 521 133
Borders	Tel: 01896 825 560	out of hours 01896 826 000
Dumfries and Galloway	Tel: 01387 272 724	out of hours 01387 246 246
Fife	Tel: 01592 226 435	out of hours 01592 643 355
Forth Valley	Tel: 01786 463 031	out of hours 01786 434 000
Grampian	Tel: 01224 558 520	out of hours 0845 456 6000
Greater Glasgow & Clyde	Tel: 0141 201 4917	out of hours 0141 211 3600
Highland	Tel: 01463 704 886	out of hours 01463 704 000
Lanarkshire	Tel: 01698 206 326	out of hours 01236 748 748
Lothian	Tel: 0131 536 9192	out of hours 0131 242 7444
Orkney	Tel: 01856 888 270	out of hours 01856 888 000
Shetland	Tel: 01595 743 340	out of hours 01595 743 000
Tayside	Tel: 01382 596 976	out of hours 01382 660 111
Western Isles	Tel: 01851 702 997	out of hours 01851 704 704

**National Poisons Information Service Tel. 0844 892 0111**

Advice & information on the clinical management of poisoning.

**TOXBASE (<http://www.toxbase.org>)**

Clinical toxicology database of the UK NPIS.

Registration required; free to NHS users.

Further information on assays is available from NPIS or

[www.assayfinder.co.uk](http://www.assayfinder.co.uk)



# Chemical Agents Clinical Action Guide

Exposures, Diagnosis and Management



Chemical  
Biological  
Radiological  
Nuclear