Morphine Sulfate

MAJOR ACTIONS
- Acts as a narcotic analgesic that alters the perception of pain and elevates the pain threshold.
- Relaxes respiratory effort and decreases ventilatory rate and tidal volume.
- Causes peripheral vasodilatation, thereby decreasing venous return to the heart.
- Increases vagal tone.
- Relieves pulmonary congestion caused by cardiogenic pulmonary edema.
- Lowers myocardial oxygen demand.
- Causes constriction of the pupil (miosis).
- Maximum effect is seen within 20 minutes.

INDICATIONS
- Cardiac chest pain.
- Cardiogenic pulmonary edema.
- Isolated fractures with time delays and without signs of other trauma.
- Burns without signs of trauma.
- Severe frostbite without signs of trauma during rewarming.

DOSAGE
- Adult: 1 to 3 mg slow IV push, repeat every 5 minutes as necessary. Do not exceed 0.2 mg/kg.
- Pediatric: 0.1 to 0.2 mg/kg slow IV push over 3 to 5 minutes.

PRECAUTIONS
- May cause hypotension; use with caution in patients with hypotension before administration.
- May cause respiratory depression and arrest.
- Contraindicated in patients with hypovolemia.
- Contraindicated in patients with head injuries, abdominal pain, or multiple trauma.
- Contraindicated in patients with respiratory difficulties (except pulmonary edema).
- May cause nausea and vomiting.
- Hepatic or renal insufficiency.
- If used, have naloxone (Narcan) and resuscitation equipment available.

HOW SUPPLIED
- Morphine sulfate
- 1-mg/1 ml ampule (1 mg/ml)
- 2-mg/1 ml ampule (2 mg/ml)
- 10-mg/1 ml ampule, Tubex (10 mg/ml)
- 10-mg/10 ml preloaded syringe (1 mg/ml)
Proparacaine Hydrochloride
Ophthalmic Solution
(Alcaine, Kainair, Ocu-caine, Ophthaine, Ophthalmic)

MAJOR ACTIONS
• Stabilizes the neuronal membrane and prevents the initiation and transmission of
nerve impulses.
• NOTE: Proparacaine hydrochloride is a short-acting topical anesthetic; the effects be-
gin within 20 to 30 seconds of application. Duration of action is about 15 minutes.

INDICATIONS
• Pain relief to assist eye irrigation and the use of Morgan Therapeutic Eye Irrigation
  lens.

DOSAGE
• Adults and pediatrics
  1 to 2 drops of 0.5% solution in affected eye.
• For longer transports, 1 to 2 drops every 5 to 15 minutes, up to a maximum of
  3 doses.

PRECAUTIONS
• Transient signs and symptoms. stinging, burning, and conjunctival redness may
  occur.
• Severe allergic reactions may occur. Check for allergies to “caine” type anesthetics
  before administration.
• Warn patient not to rub or touch eyes.
• Do not use discolored solution.
• Store in tight, light-resistant container at room temperature until opened. Store in a
  tight container under refrigeration after opened.
• Use with caution in patients with cardiac problems or hyperthyroidism.
• For short-term use only. Long term use may cause corneal opacification.

HOW SUPPLIED
• Proparacaine hydrochloride
• 0.5% solution in 15-ml dispenser
Sodium Bicarbonate

MAJOR ACTIONS
- Acts as an alkalinizing agent and main component of bicarbonate-carbonic acid buffer system.
- Dissociates to yield free bicarbonate ions.
- Bicarbonate ions combine with hydrogen ions produced by metabolic acidosis or hypoxia-induced anaerobic metabolism to maintain acid-base balance.

INDICATIONS
- Cardiac arrest (if indications of preexisting metabolic acidosis and only after other treatments have been used).
- Metabolic acidosis.
- Severe hypercalcemia.
- Hyperkalemia.
- Certain toxic exposures (see specific guideline).

DOSEAGE
- Adult: 1 mEq/kg (1 ml/kg of 8.4% solution) IV as an initial dose; then 0.5 mEq/kg every 10 minutes.
- Pediatric: 1 mEq/kg (1 ml/kg of 8.4% solution) IV or IO over 1 minute as an initial dose; then 0.5 mEq/kg every 10 minutes. A dilute solution 4.2% (0.5 mEq/ml) may be used in neonates.
- Whenever possible, any usage should be guided by blood gas determination.
- NOTE. In cardiac arrest, sodium bicarbonate therapy should be considered only after the confirmed interventions such as defibrillation, cardiac compression, intubation, ventilation, and more than one trial of epinephrine have been used.

PRECAUTIONS
- Can cause alkalosis, which may cause as many problems as acidosis.
- Can increase intravascular volume and increase cardiac workload.
- May increase cerebral acidosis if patient is not being adequately ventilated.
- Precipitates if given with calcium chloride.
- Deactivates catecholamines if given in same line without adequate flushing.

HOW SUPPLIED
- 10-mEq/10 ml preloaded syringe (1 mEq/ml) 8.4%
- 50-mEq/50 ml preloaded syringe (1 mEq/ml) 8.4%
- 44.6-mEq/50 ml preloaded syringe (0.9 mEq/ml) 7.5%
- 5-mEq/10 ml vial (0.5 mEq/ml) 4.2%
Albuterol (Salbutamol, Proventil, Ventolin)

MAJOR ACTIONS
- Relaxation of bronchial smooth muscle by stimulating Beta₂ adrenergic receptors.
- May cause some vasodilation.

INDICATIONS
- Pulmonary edema from toxic exposure accompanied by auscultatable wheezes.
- Reversible bronchospasm.
- Asthma.
- Bronchospasm that occurs in association with bronchitis and emphysema.

DOSAGE
- Adult: Nebulized—2.5 mg in 3 to 4 ml NS. Dose may be repeated every 1 to 4 hours as needed. Higher doses (up to 2.5 mg every 15 minutes as needed) may be used for acute attacks (limited by cardiac and other adverse effects).
- Pediatric: Nebulized—0.15 mg (0.03 ml)/kg to a maximum of 2.5 mg in 3 to 4 ml NS. Dose may be repeated every 1 to 4 hours as needed.

PRECAUTIONS
- Contraindicated in patients with cardiac arrhythmias associated with tachycardia.
- Administer with caution in patients with hypertension, hyperthyroidism, diabetes, hypokalemia, congestive heart failure, coronary artery disease, renal insufficiency, hepatic insufficiency, or sensitivity to sympathomimetic amines.
- May cause: tachycardia, hypertension, palpitations, nervousness, tremor, nausea, vomiting, muscle cramps, hypotension and hypokalemia, and hyperglycemia.
- May cause paradoxical bronchospasm from repeated excessive use.
- Store in light-resistant containers.

HOW SUPPLIED
- Albuterol sulfate
- 50-mg/10 ml bottle. nebulizer solution (5 mg/ml 0.5% solution)
- 2.5-mg/2.5 ml ampule, nebulizer solution (1 mg/ml)
Aminophylline
(Theophylline Derivative)

MAJOR ACTIONS
- Competitive blocker of phosphodiesterase. Increases active levels of 3',5'-adenosine monophosphate (cAMP).
- Releases free theophylline.
- Acts as a smooth muscle relaxant.
- Produces bronchodilation.
- Produces vasodilation.
- Acts as a mild diuretic.
- CNS stimulation.
- Stimulates the cardiovascular system and increases cardiac output.
- Stimulates the respiratory drive.
- Increases contractility of the diaphragm.

INDICATIONS
- Bronchospasm.
- Pulmonary edema with associated wheezing.
- Asthma, anaphylaxis, or COPD with wheezing

DOSAGE
- Adult: Loading dose 4 to 6 mg/kg in 50 to 250 ml of D₅W administered through a Volutrol over a minimum of 30 minutes.
- Pediatric: Loading dose 4 to 6 mg/kg in 50 to 250 ml of D₅W administered through a Volutrol over a minimum of 30 minutes.
- NOTE: These dosages are used only if patient is not taking theophylline compounds; otherwise, dose should be determined by medical control.
- Anhydrous aminophylline is only 85% theophylline
- Theophylline has a low therapeutic index; therefore serum concentration monitoring is essential.
- A maintenance dose to maintain serum theophylline concentration in the 10 to 20 µg/ml range should follow the loading dose. Dose should be determined by medical control.
- The maintenance dose must be properly adjusted for children; smokers; and adults with cor pulmonale, CHF, COPD, and liver disease. Dose should be determined by medical control.

PRECAUTIONS
- May cause atrial and ventricular ectopy. Also may cause tachycardias. Place patient on monitor before administration.
- May cause hypotension.
- Can cause nausea, vomiting, and headache.
- May cause seizures.
- Use with extreme caution in patients with severe hypoxia.
- Use with caution in children.
- Contraindicated if patient is allergic to xanthine compounds.
- Reduce dose if patient is taking theophylline preparations.
· If possible, draw blood sample for theophylline serum concentration prior to administration.

**HOW SUPPLIED**

· Aminophylline (hydrous)
· 500-mg/10 ml ampule (50 mg/ml)
· 500-mg/20 ml ampule, preloaded syringes (25 mg/ml)
· 250-mg/10 ml ampule, preloaded syringes (25 mg/ml)
Metaproterenol Sulfate
(Alupent)

MAJOR ACTIONS
- Synthetic sympathomimetic amine with similar structure and action to that of isoproterenol.
- Inhalant solution has a rapid onset of action.
- Decreases reversible bronchospasm. Increases FEV₁.

INDICATIONS
- Pulmonary edema from toxic exposure accompanied by auscultatable wheezes.
- Reversible bronchospasm.
- Bronchial asthma.
- Bronchospasm that occurs in association with bronchitis and emphysema.

DOSEAGE
- Adult: one unit dose vial of 0.6% solution per nebulization treatment. If 5% solution is used, dilute 0.3 ml of solution to 2.5 ml with normal saline. Should not be repeated for 4 hours.
- Pediatric: Inhalant solution is not recommended for use in children under 12 years of age.

PRECAUTIONS
- Administered via nebulizer.
- Contraindicated in patients with cardiac arrhythmias associated with tachycardia.
- Do not administer with another sympathomimetic agent.
- Administer with caution in patients with hypertension, hyperthyroidism, diabetes, congestive heart failure, or coronary artery disease.
- May cause tachycardia, hypertension, palpitations, nervousness, tremor, nausea, and vomiting.
- May cause paradoxical bronchospasm from repeated excessive use.
- Do not use if solution is brown in color or has precipitated.
- Store in 15° to 25° C environment and protect from light.

HOW SUPPLIED
- Metaproterenol sulfate
- Inhalant solution, unit-dose vials 0.4% or 0.6% containing 2.5 ml solution
- Inhalant solution, 5% in bottles of 10 ml or 30 ml with accompanying calibrated dropper.
Oxygen

MAJOR ACTIONS
- Oxygen administration elevates arterial oxygen tension, increases arterial oxygen content, and improves tissue oxygenation.

INDICATIONS
- Suspected hypoxemia from any cause.
- Respiratory distress.
- Shock.
- Suspected myocardial infarction.
- Toxic exposures resulting in respiratory depression, acidosis, or decreased levels of consciousness.
- Coma or altered state of consciousness
- Cardiac or respiratory arrest.

DOSAGE
- Refer to Oxygen Adjuncts Chart below.

▼ Oxygen Adjuncts

<table>
<thead>
<tr>
<th>Administration sets</th>
<th>Liters/Min</th>
<th>%O₂</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nasal cannula (NC)</td>
<td>1-6 L/min</td>
<td>25-45</td>
</tr>
<tr>
<td>Simple face mask (SFM)</td>
<td>6-12 L/min</td>
<td>35-55</td>
</tr>
<tr>
<td>Partial rebreather (PRB)</td>
<td>10-15 L/min</td>
<td>55-70</td>
</tr>
<tr>
<td>Nonrebreather (NRB)</td>
<td>10-15 L/min</td>
<td>90</td>
</tr>
<tr>
<td>Pocke face mask (PFM)</td>
<td>10 L/min</td>
<td>50</td>
</tr>
<tr>
<td>Bag valve mask (BVM)</td>
<td>10-15 L/min</td>
<td>100 (with reservoir)</td>
</tr>
<tr>
<td></td>
<td>(BVM)</td>
<td>10-15 L/min</td>
</tr>
<tr>
<td></td>
<td>(BVM)</td>
<td>Room Air</td>
</tr>
<tr>
<td>SFM at 10 L/min + NC at 6 L/min.</td>
<td></td>
<td>75%</td>
</tr>
</tbody>
</table>

Formula for Calculating Duration of Oxygen Cylinder Flow

\[
\text{Actual Gauge Pressure in PSI} - \text{Safe residual pressure [200] \times constant} = \text{Duration of flow in minutes}
\]

\[
\frac{\text{Desired flow rate (liters per minute)}}{\text{Constant}}
\]

Constants used for various-sized cylinders

<table>
<thead>
<tr>
<th>Cylinder</th>
<th>D</th>
<th>E</th>
<th>G</th>
<th>H</th>
<th>K</th>
<th>M</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>0.16</td>
<td>0.28</td>
<td>2.41</td>
<td>3.14</td>
<td>3.14</td>
<td>1.56</td>
</tr>
</tbody>
</table>
Oxygen

PRECAUTIONS
- Support ventilations as needed.
- May cause respiratory depression in a small percentage of COPD patients. Start out with a low flow if possible (2 L/min via nasal cannula). Do not withhold oxygen. Be prepared to assist ventilations.
- Drying and irritating to mucous membranes if delivery system is not humidified.
- Never deliver less than 6 L/min by mask. Expired air can accumulate and be rebreathed, thus increasing carbon dioxide levels.
Activated Charcoal

MAJOR ACTIONS
• Nonspecific adsorbent for variety of chemicals and drugs.
• By definition, commercial preparations (1 g) must adsorb 100 mg of strychnine in 50 ml of water to meet USP standards.
• Does not adsorb cyanide, ethanol, methanol, ferrous sulfate, caustics, lithium, mineral acids or hydrocarbon solvents.

INDICATIONS
• Poisonings with chemicals/drug adsorbable by activated charcoal.
• Useful for drugs which exhibit enterohepatic recirculation.
• Multiple-dose activated charcoal has proven useful for phenobarbital, theophylline, carbamazepine, and digitalis poisonings.
• Refer to specific guideline for use indications.

DOSAGE
• Oral or orogastric tube
  Adults: 30 to 100 g
  Pediatric: 30 to 50 g or 1 g/kg
• Sorbitol
  Activated charcoal is usually given with the osmotic laxative agent sorbitol to decrease GI transit time. Use with caution in cases of GI obstruction.
  Dose:
  Adult: 100 g (150 ml of 70% solution)
  Children: 1 to 2 ml/kg of 70% solution

PRECAUTIONS
• Contraindicated in caustic ingestions.
• Use with caution if decreased bowel activity or intestinal obstruction.
• Adsorbed chemical/drug may be released into the GI tract for resorption.
• Administration of activated charcoal followed by GI tract perforation and charcoal peritoneum has been reported.

HOW SUPPLIED
• Powder for suspension:
  30 g: Acta-Char
  50 g: Acta-Char
• Suspension:
  0.625 g/5 ml (15 or 30 g) in aqueous or sorbitol solution: Acta-char Insta-Char
  0.7 g/ml (50 g) in sorbitol solution: Acta-Char Liquid
  1 g/5 ml (12.5, 25, 30, 40, 50 g) in 70% sorbitol solution: Actidose, Charcoal
  Also in aqueous solution: Actidose-Aqua, Activated Charcoal Liquid, Insta-Char, Liqui-Char
Atropine Sulfate

MAJOR ACTIONS
- Antimuscarinic (blocks parasympathetic muscarinic receptor sites); inhibits acetylcholine (postganglionic cholinergic nerve blocking agent).
- Inhibits parasympathetic nervous system.
- Blocks cholinergic-mediated neuromuscular junctions.
- Increases heart rate by blocking vagal stimulation.
- Increases conduction through the AV node.
- Reduces tone and motility of the GI tract.
- Inhibits salivary, bronchial, and sweat gland secretions.
- Dilates pupils (mydriasis).

INDICATIONS
- Sinus bradycardia or ventricular rates with hypotension.
- Asystole and high-degree blocks with slow ventricular rates.
- Specific physiological antagonist for toxic exposures of organophosphates, carbamates, and nerve gases.

DOSAGE
- Adult:
  Bradycardia: 0.5 to 1 mg IV push, repeat every 3 to 5 minutes as needed up to a maximum of 0.04 mg/kg. A total dose of 3 mg (0.04 mg/kg) results in full vagal blockade (cardiac) in humans.
  Asystole: a 1-mg bolus should be given initially and repeated in 3 to 5 minutes.
  Symptomatic toxic exposure to organophosphates, carbamates, or similar acting nerve gases: Initial dose: 2 mg IV push. Repeat this dose (2 mg) every 3 to 5 minutes as needed. Atropine should be given until the lungs are clear to auscultation.
- Pediatric:
  Cardiac arrhythmias. 0.02 mg/kg IV push, with a minimum dose of 0.1 mg and a maximum single dose of 0.5 mg in a child and 1 mg in an adolescent. The dose may be repeated in 5 minutes, to a maximum total dose of 1 mg in a child and 2 mg in an adolescent.
  Symptomatic toxic exposure to organophosphates, carbamates, or similar acting nerve gases: Initial dose 0.05 to 0.1 mg/kg IV push up to maximum of 2 mg. Repeat this dose (0.05 to 0.1 mg/kg, maximum of 2 mg) every 3 to 5 minutes as needed. Atropine should be given until the lungs are clear to auscultation.
- NOTE: Initial atropine dose may be given IM or via ET tube, since the required dosage may be very large; switch to IV route as soon as possible.
- For severely poisoned patients, a continuous infusion at 0.01 to 0.03 mg/kg/min may be required.

PRECAUTIONS
- Severely poisoned patients are relatively atropine resistant. They do not respond to the drug as do patients with cardiac instability. Massive amounts may be necessary.
- Adequate oxygenation and ventilation should be assessed before atropine administration.
• Smaller doses of atropine may produce paradoxical bradycardia.
• Do not treat bradycardia (heart rate <60) unless signs of inadequate perfusion (hypotension) are present. In acute myocardial infarction, infarct size may be enlarged by increasing myocardial oxygen demand.
• Increases intraocular pressure.
• Dilates the pupils.
• Hepatic or renal insufficiency.
• If large doses are necessary, preservative-free preparations should be used.

**HOW SUPPLIED**
• Atropine sulfate
• 1-mg/10 ml preloaded syringes (0.1 mg/ml)
• 0.5-mg/5 ml preloaded syringes (0.1 mg/ml)
• 1-mg/1 ml ampule (1 mg/ml)
• In multi-dose vials of 8 mg/20 ml (0.4 mg/ml)
Calcium Gluconate

MAJOR ACTIONS
• Used to treat hydrofluoric acid (HF) and fluoride toxicity.
• Binds the fluoride ion preventing tissue and systemic injury.
• Depending on the type and extent of exposure, calcium gluconate may be administered via several routes. Calcium gluconate gel may be administered topically. Subcutaneous (SQ) injections or intraarterial (IA) infusion may be used for definitive treatment of local injuries. IV therapy may be needed for systemic signs and symptoms.
• For local injury, the end point of therapy is the elimination of pain.
• For systemic poisoning, therapy should be guided by clinical presentation and laboratory values.

CALCIUM GLUCONATE GEL

INDICATIONS
• Mild-to-moderate skin burns resulting from exposure to HF.

DOSAGE
• To make 2.5% w/v gel: mix 3.5 g of USP Calcium Gluconate powder in 5 oz of water-soluble lubricant (KY or Surgilube) and apply over painful areas. Cover with sterile dressings.
• Product must be mixed; it is not available for sale in the United States.
• An over-the-counter 2.5% calcium gluconate gel (H-F Antidote Gel) preparation is available from Pharmascience, Inc., Montreal, Quebec.

PRECAUTIONS
• Skin surface may look normal; burn is in lower skin layers.
• Bone tissue may be involved
• Severe burns may require SQ or IA injections; thus rapid transport to medical facility is essential.
• Watch for systemic poisoning signs and symptoms.

SUBCUTANEOUS INJECTIONS

INDICATIONS
• Moderate-to-severe local tissue damage resulting from exposure to HF.
• Patients with no significant pain relief after 45 minutes of topical treatment.

DOSAGE
• Calcium gluconate 10% is infiltrated into the subcutaneous tissue using a 30-gauge needle.
• Injected volume should not exceed 0.5 ml/cm².
• Nail removal may be necessary, but some evidence suggests that nail removal may not be necessary if the patient was exposed to less than 10% HF.

PRECAUTIONS
• Small surface area exposure to dilute solutions of HF may not require SQ injections.
• Extremely painful procedure. Local anesthesia should not be used since the therapeutic end point is pain reduction.
Calcium Gluconate

- Should only be performed by a physician experienced in this procedure.
- Calcium chloride is irritating to the tissues and should not be used.
- Excessive administration may result in vascular compromise.
- Burn symptoms may be delayed for several hours. Treatment should be guided by history and clinical presentation.
- Watch for systemic poisoning signs and symptoms.

INTRAARTERIAL INJECTIONS

INDICATIONS
- Moderate-to-severe extremity tissue damage resulting from exposure to HF.
- Patients with no significant pain relief after 45 minutes of topical treatment.

DOSAGE
- Perform an arteriogram to determine which artery supplies the affected tissue.
- Mix 10 ml of calcium gluconate with 50 ml of 5% dextrose solution and administer over a 4-hour period intraarterially using a parenteral infusion pump.
- Repeat if pain recurs.
- If patient does not experience pain relief, repeat arteriogram to ensure correct artery selection.

PRECAUTIONS
- Small surface area exposure to dilute solutions of HF may not require IA injections.
- An invasive procedure requiring hospital administration.
- Should be performed by an experienced physician.
- Ensure adequate tissue perfusion.
- Burns may be delayed for several hours. Treatment should be guided by history and clinical presentation.
- Watch for systemic poisoning signs and symptoms.

INTRAVENOUS INJECTIONS

INDICATIONS
- Systemic poisoning resulting from exposure to HF.
- Hypocalcemia secondary to HF exposure.
- If serum calcium concentration is not readily available: when there is a history of HF exposure, patient is symptomatic, and has ECG changes consistent with hypocalcemia (prolonged QT interval).

DOSAGE
- Administer 0.1 to 0.2 ml/kg IV up to 10 ml. Repeat dose as necessary.
- Larger than usual doses may be necessary.
- Therapy should be guided by serum calcium and serum potassium determinations.

PRECAUTIONS
- Closely monitor ECG, serum calcium, and serum potassium concentration during therapy.
- Hypotension, bradycardia, and arrhythmias may occur.
- Contraindicated in patients with digitalis toxicity.
Cyanide Antidote Kit

MAJOR ACTIONS
- Amyl nitrite (AN) reacts with hemoglobin (HB) to form an approximate 5% methemoglobin (MHB).
- Sodium nitrite (NaNO₂) reacts with hemoglobin to form an approximate 20% to 30% methemoglobin. Methemoglobin attracts cyanide (CN) ions from tissue and binds with them to become cyanmethemoglobin (CNMHB).
- Sodium thiosulfate (Na₂S₂O₃) converts cyanmethemoglobin to thiocyanate (HSCN), which is excreted by the kidneys.

Chemical reaction:
\[
\begin{align*}
AN &+ HB = MHB \\
NaNO₂ &+ HB = MHB \\
CN &+ MHB = CNMHB \\
Na₂S₂O₃ &+ CNMHB + O₂ = HSCN
\end{align*}
\]

- Amyl nitrite, sodium nitrite, and sodium thiosulfate administered in that order, are the only therapy against cyanide and hydrocyanic acid poisoning currently approved by the FDA.

INDICATIONS
- Treatment of poisoning from cyanide-releasing compounds.
- Treatment of poisoning from cyanide metabolites.
- Use of amyl nitrite and sodium nitrite for hydrogen sulfide poisoning.

DOSAGE
- Adult
  Aspiroils of amyl nitrite should be broken and be held, one at a time, in front of patient’s nose. They should be left in place for 15 seconds and followed with a 15-second rest and repeated until sodium nitrite can be administered. This produces an approximate 5% methemoglobin. The use of amyl nitrite should not delay prompt respiratory support. In case of respiratory arrest, place aspiroil inside bag-valve-mask and ventilate (remove after 15 seconds, ventilate for 15 seconds, and repeat) until sodium nitrite can be administered.
  Stop amyl nitrite administration and administer 300 mg of sodium nitrite (10 ml of 3% solution) by IV push over 5 minutes. This produces a theoretical 20% to 30% methemoglobin.
  Immediately follow sodium nitrite with 12.5 g of sodium thiosulfate (50 ml of a 25% solution) IV push over 5 minutes.
  If toxic signs reappear, repeat both sodium nitrite and sodium thiosulfate at one half the original dose.
- Pediatric
  Aspiroils of amyl nitrite should be broken and held, one at a time, in front of patient’s nose. They should be left in place for 15 seconds, followed by a 15-second rest, and repeated until sodium nitrite can be administered. This produces an approximate 5% methemoglobin. The use of amyl nitrite should not delay prompt respiratory support. In case of respiratory arrest, place aspirol
inside bag-valve-mask and ventilate (remove after 15 seconds, ventilate for 15
seconds, and repeat) until sodium nitrite can be administered.

**Sodium nitrite dose:** Must be based on child’s hemoglobin concentration or body
surface area (BSA) or weight. The hemoglobin-based dose is preferred. In most
cases, the hemoglobin concentration will not be readily available. The normal
hemoglobin for a child is approximately 12 g. **Failure to dose according to one
of these dosing parameters may lead to a fatal overdose of sodium nitrite.**

a. Sodium nitrite dose based on hemoglobin concentration:

<table>
<thead>
<tr>
<th>Hemoglobin in grams</th>
<th>Initial IV dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>0.22 ml (6.6 mg)/kg</td>
</tr>
<tr>
<td>10</td>
<td>0.27 ml (8.7 mg)/kg</td>
</tr>
<tr>
<td>12</td>
<td>0.33 ml (10 mg)/kg</td>
</tr>
<tr>
<td>14</td>
<td>0.39 ml (11.6 mg)/kg</td>
</tr>
</tbody>
</table>

Do not exceed 10 ml or 300 mg.

b. Sodium nitrite dose based on BSA:
6 to 8 ml/m³ or approximately 0.2 ml/kg IV
Do not exceed 10 ml or 300 mg.

c. Sodium nitrite dose based on body weight estimation: If a child weighs less
than 25 kg and it is not possible to obtain a hemoglobin determination,
administer:
10 mg/kg (0.33 ml/kg)
Do not exceed 10 ml or 300 mg.

* Sodium thiosulfate dose: Calculate dosage either on hemoglobin concentration, BSA,
or child’s weight.

a. Sodium thiosulfate dose based on hemoglobin concentration:

<table>
<thead>
<tr>
<th>Hemoglobin in grams</th>
<th>Initial IV dose</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>1.10 ml/kg</td>
</tr>
<tr>
<td>10</td>
<td>1.35 ml/kg</td>
</tr>
<tr>
<td>12</td>
<td>1.65 ml/kg</td>
</tr>
<tr>
<td>14</td>
<td>1.95 ml/kg</td>
</tr>
</tbody>
</table>

Do not exceed 12.5 g.

b. Sodium thiosulfate IV dose based on BSA:
7 g /m³
Do not exceed 12.5 g.

c. Sodium thiosulfate IV dose based on body weight: If a child weighs less than
25 kg and it is not possible to rapidly obtain a hemoglobin determination,
administer:
1.65 ml/kg of the 25% solution.
Do not exceed 12.5 g.

* If toxic signs reappear, repeat both sodium nitrite and sodium thiosulfate at one half
the original dose.

**PRECAUTIONS**

* If signs of methemoglobinemia occur (i.e., severe cyanosis, vomiting, coma, and
shock), administration of 1% methylene blue is controversial, because bound cyanide
may be released. Give only under **direct medical control physician verbal order.**
(Refer to methylene blue protocol in Section Four).
Cyanide Antidote Kit

- Both sodium nitrite and amyl nitrite in excessive doses can induce a dangerous methemoglobinemia and can be fatal. Monitor methemoglobin concentrations.
- Sodium nitrite can cause hypotension.
- Drug therapy should be in addition to ventilation, oxygen therapy, and rapid transport.

HOW SUPPLIED
- Lilly Cyanide Antidote Package

SPECIAL CONSIDERATIONS
- Other cyanide treatments
  4-dimethylaminophenol (DMAP) is used in Europe as a methemoglobin-generating agent.
  Hydroxycobalamin (vitamin B₁₂a) is widely used in Europe and is under investigation in the United States. Hydroxycobalamin works by reacting with cyanide to form cyanocobalamin (vitamin B₁₂) which is excreted in the urine.
  Dicobalt edetate (Kelocyanor) is currently used in Europe. It acts by chelating cyanide to form stable cobalticyanide, which is excreted in the urine.
- Hyperbaric therapy may increase the efficiency of the cyanide antidote kit.
Ethanol (Ethyl Alcohol)

MAJOR ACTIONS
- Hepatic alcohol dehydrogenase has preferential affinity for ethanol.
- Administration of ethanol saturates alcohol dehydrogenase and blocks the metabolism of either methanol or ethylene glycol to toxic byproducts. Methanol or ethylene glycol is therefore excreted unchanged.

INDICATIONS
- In-hospital treatment for poisoning with methanol or ethylene glycol.

DOSEAGE
- Adult: IV loading dose of 0.7 to 0.8 g/kg. Administer 10 ml/kg of a 10% ethanol solution (0.75 g/10 ml). A maintenance dose of 0.1 g/kg/hr (1.4 ml/kg/hr of 10% ethanol) should be established to maintain a serum ethanol concentration of 100 to 125 mg/dl.

PRECAUTIONS
- Because a 10% solution is the highest concentration that can be administered safely by the IV route, a large amount of solution may be needed. An 80-kg patient requires an 800-ml loading dose. Monitor for pulmonary edema during administration.
- The maintenance dose must be adjusted in chronic alcoholics and during dialysis to maintain a serum alcohol level of 100 to 125 mg/dl.
- Maintenance therapy should be guided by determination of serum ethanol concentrations.
- May cause CNS depression, respiratory depression, hypothermia, hypotension, nausea, vomiting.
- Hypoglycemia may occur after prolonged therapy.
- Therapy should be started as soon as possible after exposure.
- Ethanol therapy is of limited value as it may take several days to excrete the methanol or ethylene glycol. Definitive treatment is hemodialysis. Ethanol treatment is therefore used to block alcohol dehydrogenase metabolism while preparations are made for hemodialysis.

HOW SUPPLIED
- Absolute ethanol (95%) must be diluted to 10% v/v for IV administration
- 10% Ethanol and 5% dextrose for injection
- 5% Ethanol and 5% dextrose for injection

ANION GAP/OSMOL GAP
- Calculation of the anion gap is a useful way to assess the acid-base status of the patient poisoned by ethylene glycol or methanol.
- The formula for normal anion gap (AG) calculation is:

$$\left[Na^+\right] + \left[K^+\right] - \left(Cl^-\right) + \left[HCO_3^-\right] = AG$$

Normal range is 8 to 13 mEq/L.

- The normal anion gap is caused by serum phosphates, sulfates, and various organic acids.
- In cases of metabolic acidosis such as in ethylene glycol or methanol poisoning, the anion gap is increased, thus providing a clue to the presence of excess anions.
Ethanol (Ethyl Alcohol)

- Determination of the difference between the measure of serum osmolality and calculated osmolality may be useful in the diagnosis of ethylene glycol, methanol, or isopropyl alcohol poisoning.
- The formula for calculating serum osmolality is:
  \[ \text{mOsm/kg H}_2\text{O}_{\text{calc}} = 2(\text{Na}^+) + \text{Glucose}/18 + \text{BUN}/2.8 \]
- Normal value for the osmolar gap (OG) is 10 mOsm/kg H\textsubscript{2}O. Values greater than this may indicate the presence of other low-molecular-weight molecules such as ethylene glycol, methanol, or isopropyl alcohol. Because of the many inherent sources of error in the estimation of the OG, low to normal OG values do not necessarily rule out poisoning.
Flumazenil (Mazicon, 1,4-imidazodiazepine)

MAJOR ACTIONS
- Benzodiazepine CNS antagonist.
- Blocks benzodiazepine receptor sites.
- Duration of action is 15 to 140 minutes.
- Shorter duration of action than most benzodiazepines. Half-life: 60 minutes.

INDICATIONS
- Complete or partial reversal of benzodiazepine-induced sedation for general anesthesia or diagnostic procedures.
- May be useful in cases of overdoses from benzodiazepines.

DOSEAGE
- Adults (not recommended for children under 18 years old):
  
  *Reversal of benzodiazepine sedation:*
  
  0.2 mg IV over 15 seconds. If desired consciousness level not achieved after 45 seconds, up to four additional doses may be given at 1-minute intervals up to a maximum dose of 1 mg over the 5-minute period. If sedation recurs, follow initial dose regimen up to 1-mg total dose over a 20-minute period. May be repeated twice for a 3-mg total dose over the 1-hour period.

  *Suspected benzodiazepine overdose:*
  
  0.2 mg IV over 30 seconds. If desired response not obtained after waiting 30 seconds, administer 0.3 mg IV over 30 seconds. If still suboptimal response, additional doses of 0.5 mg may be given over 30 seconds at 1-minute intervals up to a cumulative dose of 3 mg. Rarely, patients exhibiting a partial response may require additional 0.5-mg doses for a cumulative dose of 5 mg. If symptoms return, 1 mg divided into 0.5-mg IV doses at 1-minute intervals may be given every 20 minutes up to a maximum total dose of 3 mg/hr.

  *NOTE: Only a few patients have been reported to require a total dose of 5 mg.*

PRECAUTIONS
- Flumazenil should not be considered as a replacement for adequate airway, ventilatory management, and supportive care in cases of benzodiazepine oversedation or overdose. Respiratory depression not always reversed with Flumazenil.
- May cause seizures. Do not use in overdoses likely to cause seizures.
- Do not use for mixed benzodiazepine and cyclic antidepressant overdoses.
- May precipitate withdrawal symptoms in patients with physical dependence on benzodiazepines or patients using benzodiazepines for seizure control.
- May cause cardiac arrhythmias.

HOW SUPPLIED
- Parenteral injection for IV use only: 0.1 mg/ml
Methylene Blue 1%

MAJOR ACTIONS
- Methylene blue is a thiazine dye.
- Two opposite actions on hemoglobin:
  - Low doses of methylene blue reduce methemoglobin to hemoglobin.
  - High doses oxidize hemoglobin iron in the ferrous state (Fe^{2+}) to ferric iron (Fe^{3+}) forming methemoglobin. Only iron in the ferrous state can bind with oxygen.

INDICATIONS
- Poisoning causing methemoglobinemia greater than 30%.
- Methemoglobinemia with signs/symptoms of hypoxia.

DOSAGE
- Adult: 1 to 2 mg/kg (0.1 to 0.2 ml/kg) of a 1% solution given slow IV push over 5 minutes. Repeat as necessary up to total dose of 7 mg/kg.
- Pediatric: Same as adult.

PRECAUTIONS
- For IV use only.
- Must be injected slowly over a period of 5 minutes to prevent local high concentration of the compound from producing additional methemoglobin.
- Do not exceed recommended dosage.
- Large doses may produce nausea, chest and abdominal pain, dizziness, headache, profuse sweating, mental confusion, and the formation of methemoglobin.
- Tissue infiltration may cause necrotic abscesses.
- Contraindicated in patients with glucose-6-phosphate deficiency (G6PD).
- Provides reversible oxidation-reduction by red blood cell methemoglobin reductase to its colorless form, leukomethylene blue. Leukomethylene blue reduces methemoglobin to hemoglobin. Reaction may go both ways.
- Gives urine, feces, and glandular secretions blue-green color.
- May stain skin
- Do not use in renal failure.

HOW SUPPLIED
- 10-mg/1 ml ampule
- 10-mg/10 ml ampule
Naloxone (Narcan)

MAJOR ACTION
- Acts as a narcotic (opiate) antagonist.
- Rapid onset of actions.

INDICATIONS
- Used to reverse narcotic effects, especially respiratory depression.
- A diagnostic tool in coma or seizures without a reliable history.

DOSAGE
- Adult: 0.1 to 2 mg slow IV
- Pediatric: 0.01 mg/kg slow IV
- NOTE: Doses may be repeated at 2- to 3-minute intervals if necessary.
- May be given via ET or IM routes.

PRECAUTIONS
- May precipitate opiate withdrawal symptoms. Withdrawal can be violent; try to titrate dose to reverse respiratory depression only.
- May cause hypertension and tachycardia.
- If no response in adult after a total dose of 10 mg, continued administration is probably of no value.
- Since the half-life of Narcan is shorter than many narcotics, symptoms may recur. Repeated doses may be necessary.

HOW SUPPLIED
- 0.4-mg/1 ml ampule, preloaded syringe (0.4 mg/ml)
- 1-mg/1 ml ampule, preloaded syringe (1 mg/ml)
- 2-mg/2 ml ampule, preloaded syringe (1 mg/ml)
- 0.04-mg/2 ml ampule (0.02 mg/ml) neonatal
Pralidoxime Chloride
(Protopam Chloride, 2PAM Chloride, 2-Pyridine Aldoxime Methochloride)

MAJOR ACTIONS
• Quaternary ammonium oxime acting as a cholinesterase reactivator.
• Binds with organophosphate (OP), removing it from cholinesterase, restoring cholinesterase function.
• Acts at nicotinic and muscarinic cholinergic receptor sites.
• Synergistic with atropine. Nicotinic site activity relieves paralysis of the respiratory muscles.
• NOTE: Administer as soon as possible after cholinesterase poisoning—preferably within the first 24 hours, before enzyme-OP complex “ages” (covalently bonds). Once covalent bonding occurs, the cholinesterase moiety is irreversibly inactivated. Consider administration even 48 hours or more after exposure if patient is symptomatic.
• Must be used with atropine.
• Relatively slow acting.

INDICATIONS
• Treatment of poisoning caused by the pesticides and chemicals of the organophosphate class that have anticholinesterase activity. Controversial use with carbaryl (Sevin), carbamate-type insecticide, if symptoms are severe. May be useful with other carbamate insecticide poisonings. Direct physician order only.

DOSAGE
• Adults: 1 to 2 g of Pralidoxime Chloride IV drip in 100 ml of normal saline (NS) over 15 to 30 minutes. Dose may be repeated in 1 hour if symptoms are still present. The dose can then be repeated every 6 to 8 hours as necessary for 24 to 48 hours. Symptomatic patients may require extended treatment after 48 hours.
• Pediatric: The dose is 20 to 40 mg/kg to a maximum dosage of 1 g of Pralidoxime Chloride IV drip in 100 ml of NS over 15 to 30 minutes. Dose may be repeated in 1 hour if symptoms are still present. The dose can then be repeated every 6 to 8 hours as necessary for 24 to 48 hours. Symptomatic patients may require extended treatment after 48 hours.
• If nicotinic effects persist, a continuous infusion of Pralidoxime Chloride may be used. A 2.5% concentration can be given at up to 0.5 g/hr. The continuous infusion may be more beneficial than repetitive, single-dose therapy. Treatment end point is dictated by clinical response.

PRECAUTIONS
• Tachycardia, laryngospasm, and muscle rigidity have been reported from a too-rapid infusion rate.
• Dizziness, blurred vision, diplopia, headache, drowsiness, nausea, hyperventilation, and muscle weakness have been reported.
• Impaired renal function.
• Use Pralidoxime Chloride with caution when treating organophosphate overdose in cases of myasthenia gravis, since it may precipitate a myasthenic crisis.
• Atropine and Pralidoxime Chloride are synergistic and should be used together; the signs of atropinization may occur earlier than might be expected when atropine is used alone.
• Pralidoxime Chloride is not effective in the treatment of poisoning caused by phosphorus, inorganic phosphates, or organophosphates not having anticholinesterase activity.
• Pralidoxime Chloride is not generally recommended to treat intoxication from the carbamate class of insecticides, especially carbaryl. The carbamate/cholinesterase bond is not permanent and will allow the cholinesterase to spontaneously reactivate.

**HOW SUPPLIED**
• 20-ml vial containing 1 g of sterile Pralidoxime Chloride (white to off-white porous cake) and one 20-ml ampule of sterile water for injection to be used as a diluent.