



**Mercy
Ships[®]**

Bringing Hope and Healing...

Formulary 2009-2011



**An Essential Medicines Dosing Guide
Based on the WHO Model Formulary**

ANAESTHETICS

13.01 INHALATIONAL & IV ANAESTHETICS

WHO MODEL FORMULARY 2008 NOTES:

This section describes drugs used in anaesthesia. The reader is referred to WHO. *Model Prescribing Information. Drugs used in Anaesthesia*. Geneva: WHO; 1989 for more detailed information.

To produce a state of prolonged full surgical anaesthesia reliably and safely, a variety of drugs is needed. Special precautions and close monitoring of the patient are required. These drugs may be fatal if used inappropriately and should be used by non-specialized personnel only as a last resort. Irrespective of whether a general or conduction (regional or local) anaesthetic technique is used, it is essential that facilities for intubation and mechanically assisted ventilation are available. A full preoperative assessment is required including, if necessary, appropriate fluid replacement.

Anaesthesia may be induced with an intravenous barbiturate, [propofol available with Mercy Ships], parenteral ketamine, or a volatile agent. Maintenance is with inhalational agents often supplemented by other drugs given intravenously. Specific drugs may be used to produce muscle relaxation. Various drugs may be needed to modify normal physiological functions or otherwise to maintain the patient in a satisfactory condition during surgery.

LONG-TERM MEDICATION. The risk of stopping long-term medication before surgery may be greater than the risk of continuing it. It is essential that the anaesthetist is told of **all** drugs that the patient is (or has been) taking; for further advice see section 2.10 (oral anticoagulants), section 7.01 (corticosteroids), section 7.05 (hormonal contraceptives), and section 7.03/7.04 (diabetic patients).

INTRAVENOUS ANAESTHETICS. **IV anaesthetics** may be used alone to produce anaesthesia for short surgical procedures but are more commonly used for induction only. They can produce apnoea and hypotension and thus facilities for adequate resuscitation must be available. They are contraindicated if the anaesthetist is not confident of being able to maintain an airway. Before intubation is attempted, a muscle relaxant must be given. Individual requirements vary considerably; lesser dosage is indicated in the elderly, debilitated or hypovolaemic patients. IV induction using **thiopental** is rapid and excitement does not usually occur [propofol available with Mercy Ships]. Anaesthesia persists for about 4-7 minutes; large or repeated doses severely depress respiration and delay recovery.

Anaesthesia with **ketamine** persists for up to 15 minutes after a single IV injection and is characterized by profound analgesia. It may be used as the sole

agent for diagnostic and minor surgical interventions. Subanaesthetic concentrations of ketamine may be used to provide analgesia for painful procedures of short duration such as the dressing of burns, radiotherapeutic procedures, marrow sampling and minor orthopaedic procedures. Recovery from ketamine anaesthesia is associated with a high incidence of hallucinations and other emergence reactions. Ketamine is of particular value in children, in whom hallucinations are believed to be less significant.

VOLATILE INHALATIONAL AGENTS. One of the volatile anaesthetics like ether or halothane (with or without nitrous oxide), must be used for induction when IV agents are contraindicated and particularly when intubation is likely to be difficult. [Sevoflurane is on the Mercy Ships list and should be considered in place of halothane or ether. Ether is no longer on the WHO list]. Excess bronchial and salivary secretion can be avoided by premedication with atropine. Laryngeal spasm may occur during induction and intubation. Localized capillary bleeding can be troublesome and postoperative nausea and vomiting are frequent; recovery time is slow particularly after prolonged administration. If intubation is likely to be difficult, **halothane** [or sevoflurane] is preferred. It does not augment salivary or bronchial secretions and the incidence of postoperative nausea and vomiting is low. Severe hepatitis sometimes occur and is more likely in patients who are repeatedly anaesthetized with halothane within a short period of time.

INHALATIONAL GASES. **Nitrous oxide** is used for the maintenance of anaesthesia. It is too weak to be used alone, but it allows the dosage of other anaesthetic agents to be reduced. It has a strong analgesic action. **Oxygen** should be added routinely during anaesthesia with inhalational agents, even when air is used as the carrier gas, to protect against hypoxia. Oxygen is also used in the management of anaphylaxis (section 3.02), myocardial infarction (section 2.10), and severe acute asthma (chapter 3 WHO and BNF notes).

Identification of cylinders for inhalation gases

An ISO standard (International Standard 32, Gas cylinders for medical use, 1977) requires that cylinders containing **nitrous oxide** should bear the name of the contents in legible and permanent characters and, preferably, also the chemical symbol N_2O . The neck, from the valve to the shoulder, should be coloured **blue**. Cylinders containing **oxygen** intended for medical use should bear the name of the contents in legible and permanent characters and, preferably, also the chemical symbol O_2 . The neck, from the valve to the shoulder, should be coloured **white**. Cylinders containing **nitrous oxide and oxygen mixtures** should be similarly labelled, and the neck coloured **white and blue**.

[Mercy Ships note: Please refer to current Mercy Ships anaesthesia guidelines as well. Note that nitrous oxide & oxygen are under the general needs list, not the pharmacy needs list nor the formulary list.]

GENERIC (TRADE) NAME	CAT.	INDICATION/DOSE
Isoflurane (Forane) 250ml	IDA EML	Induction, using a specifically calibrated vaporiser: gradually increase from 0.5-3% in oxygen or nitrous oxide-oxygen; maintenance 1-2.5% in nitrous oxide-oxygen.
Ketamine (as HCl) Inj 50mg/ml, 10ml (Ketalar)	IDA EML	Induction: <i>By deep IM inj</i> undiluted Adult/Child 6.5-13mg/kg (10mg/kg usually produces 12-25 minutes of anaesthesia). <i>By slow IV inj</i> over at least 1 minute (undiluted), Adult/Child 1-4.5mg/kg (2mg/kg usually produces 5-10 minutes of anaesthesia), maintenance 50-100% of induction dose as required. <i>By IV infusion</i> of a 1mg/ml solution (dilute 500mg/10ml with 490ml D5/NS), Adult/Child total induction dose 0.5-2mg/kg; maintenance (using microdrip infusion) 10-45 micrograms/kg/minute, rate adjusted according to response. Analgesia: <i>By IM inj</i> , Adult/Child initially 4mg/kg.
Nitrous Oxide Inhalation Gas [Cylinder neck: colour code blue]	EML	Anaesthesia: Adult/Child, nitrous oxide 70% mixed with 30% oxygen. Analgesia: 50% nitrous oxide mixed with 50% oxygen.
Oxygen Inhalation Gas [Cylinder neck: colour code white]	MSL EML	Concentration of oxygen in inspired anaesthetic gases should never be less than 21% (but > 80% toxic risk). Note: Fire hazard, see Comments.

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COMMENT/CAUTIONS (CONT.):

- **Ketamine contraindications:** Thyrotoxicosis, hypertension (including pre-eclampsia), history of cerebral or psychiatric disorders, eye injury.
- **Ketamine & Thiopental:** Warn patients not to perform skilled tasks, for example operating machinery or driving, and avoid alcohol, for 24 hours.
- **Nitrous oxide contraindications:** Discontinue if there is demonstrable collection of air in pleural, pericardial or peritoneal space; intestinal obstruction; occlusion of middle ear; arterial air embolism; decompression sickness; chronic obstructive airway disease or emphysema.
- **Oxygen:** FIRE HAZARD: Avoid use of cautery when oxygen is used with ether; do not grease reducing valves on oxygen cylinders (risk of explosion).
- NOTE. Nitrous oxide & oxygen are under the general needs list, not the pharmacy needs list neither the formulary list.

13.02 LOCAL ANAESTHETICS

WHO MODEL FORMULARY 2008 NOTES:

Drugs used for conduction anaesthesia (also termed local or regional anaesthesia) act by causing a reversible block to conduction along nerve fibres. Local anaesthetics are used very widely in dental practice, for brief and superficial interventions, for obstetric procedures, and for specialized techniques of regional anaesthesia calling for highly developed skills. Where patient cooperation is required the patient must be psychologically prepared to accept the proposed procedure. Facilities and equipment for resuscitation should be readily available at all times. Local anaesthetic injections should be given slowly in order to detect inadvertent intravascular injection.

LOCAL INFILTRATION. Many simple surgical procedures that neither involve the body cavities nor require muscle relaxation can be performed under local infiltration anaesthesia. Lower-segment caesarean section can also be performed under local infiltration anaesthesia. The local anaesthetic drug of choice is **lidocaine** 0.5% with or without epinephrine. No more than 4 mg/kg of plain lidocaine or 7 mg/kg of lidocaine with epinephrine should be administered on any one occasion. The addition of **epinephrine** (adrenaline) diminishes local blood flow, slows the rate of absorption of the local anaesthetic, and prolongs its effect. Care is necessary when using epinephrine for this purpose since, in excess, it may produce ischaemic necrosis. It should **not** be added to injections used in digits or appendages.

SURFACE ANAESTHESIA. Topical preparations of **lidocaine** are available and topical eye drop solutions of **tetracaine** (section 9.05) are used for local anaesthesia of the cornea and conjunctiva.

REGIONAL BLOCK. A regional nerve block can provide safe and effective anaesthesia but its execution requires considerable training and practice. Nevertheless, where the necessary skills are available, techniques such as axillary or ankle blocks can be invaluable. Either **lidocaine** 1% or **bupivacaine** 0.5% is suitable. Bupivacaine has the advantage of a longer duration of action.

SPINAL ANAESTHESIA. This is one of the most useful of all anaesthetic techniques and can be used widely for surgery of the abdomen and the lower limbs. It is a major procedure requiring considerable training and practice. Either **lidocaine** 5% in glucose or **bupivacaine** 0.5% in glucose can be used but the latter is often chosen because of its longer duration of action.

GENERIC (TRADE) NAME	CAT.	INDICATION/DOSE
<p>Bupivacaine Hydrochloride Inj 0.25% (2.5mg/ml) 0.5% (5mg/ml) 0.75% (7.5mg/ml) (Marcain)</p> <p>Preparations both with preservative and preservative-free are available. Please check.</p> <p>Use preservative-free preps for spinal, epidural, caudal or IV regional anaesthesia.</p> <p>[Max cumulative safe dose for Adult & Child of 0.25% bupivacaine is 1.5mg/kg, lower dose for debilitated, elderly, epileptic or acutely ill patients]</p>		<p>Local infiltration, using 0.25% solution: Adult up to 150mg (60ml). Peripheral nerve block, using 0.5% solution: Adult up to 150mg (30ml). Epidural block in surgery, partial to moderate motor block, using 0.5% solution: Adult 50-100mg (10-20ml); complete motor block, using 0.75% solution: Adult 75-150mg (10-20ml). Lumbar epidural block in labour, using 0.25-0.5% solution: Adult female up to 60mg (max 12ml). Caudal block in surgery, using 0.25-0.5% solution: Adult up to 150mg (max 30ml). Caudal block in labour, using 0.25-0.5% solution: Adult female up to 100mg (max 20ml). Retrobulbar block, using 0.75% solution: Adult 15-30mg (2-4ml).</p>
<p>Bupivacaine Hydrochloride Inj 0.5% (5mg/ml) with Dextrose 8.25% (82.5mg/ml), 4ml (Marcain Heavy)</p>	<p>IDA</p> <p>EML</p>	<p>Spinal anaesthesia: 2-4ml.</p>

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GENERIC (TRADE) NAME	CAT.	INDICATION/DOSE
Lidocaine HCl Topical Gel or Jelly 2% [Lignocaine]	MSL IDA EML	Local skin anaesthesia, apply as directed, see current guidelines or product leaflet for detail.
Lidocaine 2.5% with Prilocaine 2.5%, 5g cream & patch (EMLA) [Lignocaine]		Venipuncture (for Child > 1 yo): <i>apply</i> one patch or cream as a thick layer under an occlusive dressing, 1hour before procedure.
<p>Lidocaine Hydrochloride Topical Solution 40mg/ml (Xylocaine 4% Topical)</p> <p>Lidocaine Hydrochloride Topical Spray 10% 10mg/metered dose of 0.1ml (Xylocaine Spray) [Lignocaine]</p>	EML	<p>Surface anaesthesia of pharynx, larynx, trachea, using 4% solution: Adult 40-200mg (1-5ml)</p> <p>Surface anaesthesia of urethra, using 4% solution: Adult 400mg (10ml). Use minimal effective dosage according to area to be anaesthetised and procedure. See product leaflets for dosing detail.</p> <p>Using 10% solution with metered dose pump: broncho/laryngoscopy, oesophagoscopy, endotracheal intubation, up to 20 doses; maxillary sinus puncture, 3 doses; Child up to 3mg/kg</p> <p>NOTE: lidocaine can damage plastic cuffs of endotracheal tubes.</p>
Tetracaine Hydrochloride Spinal Inj 1% 2ml vial (Pontocaine/Niphanoid)	D	Spinal anaesthesia for procedures requiring two to three hours, refer to manufacturer's leaflet for dose detail.

COMMENT/CAUTIONS:

- **Lidocaine dosing:** Max dose of plain lidocaine is 4mg/kg or 200mg; max lidocaine dose when used with epinephrine is 7mg/kg or 500mg.
- When **epinephrine (adrenaline)** is used with local anaesthetics max epinephrine total dose is 500 micrograms (Adult), and higher doses of lidocaine may be used (see above, and see product leaflets).

13.03 VASOCONSTRICTORS USED IN SURGERY

WHO MODEL FORMULARY 2004 NOTES:

The sympathetic block from spinal or epidural anaesthesia may cause hypotension, which can be managed by giving IV fluids (usually prophylactically) and oxygen, and elevating legs and giving a pressor drug such as ephedrine. In addition to vasoconstriction, ephedrine also accelerates the heart rate and can counter bradycardia (but use atropine sulfate to reverse persistent bradycardia).

GENERIC (TRADE) NAME	CAT.	INDICATION/DOSE
Ephedrine HCl Inj 30mg/ml	IDA EML	To prevent hypotension during delivery under spinal anaesthesia: <i>By slow IV inj</i> (diluted in WFI to a solution of 3mg/ml), Adult 3-6 mg (max single dose 9mg), repeated if necessary every 3-4 minutes; to a max cumulative dose of 30mg.
Epinephrine Inj 1mg/ml [Adrenaline 1:1000] Caution: Different dilutions of epinephrine inj are used for different route of administration	MSL IDA EML	Anaphylaxis: <i>By SC/IM inj</i> undiluted, Adult 500 micrograms (0.5ml), 6-12 yo 250 micrograms (0.25ml), 6 mth-6 yo 120 micrograms (0.12ml), < 6 months 50 micrograms (0.05ml).
Epinephrine Inj 100 micrograms/ml, prefilled syringe 10ml (1mg/10ml) [Adrenaline 1:10 000] Caution: Different dilutions of epinephrine inj are used for different route of administration	 EML	To retard systemic absorption of infiltrated local anaesthetics: according to response, given as 5 micrograms/ml (1 in 200 000) solution diluted in NS; in dental surgery in which small volumes are injected, concentrations of up to 12.5 micrograms/ml (1 in 80 000) commonly used; total dose should not exceed 500 micrograms.
Phenylephrine Inj 1% (10mg/ml)		Acute mild-moderate hypotension: <i>By SC/IM inj</i> undiluted 2-5mg, repeat dose at 10-15 minutes intervals, max total dose 10mg; <i>by slow IV inj</i> (diluted in D5/NS as 1mg/ml solution given over 3 minutes) 0.2-0.5mg (200-500 micrograms), repeat dose at 10-15 minutes intervals.

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COMMENT/CAUTIONS:

- **Ephedrine:** Use with caution in hyperthyroidism; diabetes mellitus; ischaemic heart disease, hypertension; angle-closure glaucoma; renal impairment.
- **Epinephrine:** Contraindicated in ring block of digits, penis or other situations where there is risk of local ischaemia. Use with caution in hypertension, atherosclerotic heart disease, cerebral vascular insufficiency, heart block; thyrotoxicosis or diabetes mellitus.

13.04 MUSCLE RELAXANTS USED IN SURGERY

WHO MODEL FORMULARY 2008 NOTES:

Muscle relaxants used in surgery are classified according to their mode of action as depolarizing or non-depolarizing neuromuscular blocking drugs. Their use allows abdominal surgery to be carried out under light anaesthesia. They should never be given until it is certain that general anaesthesia has been established and ventilation must be mechanically assisted until they have been completely inactivated. **Suxamethonium** is the only widely used depolarizing muscle relaxant. It produces rapid, complete paralysis, which is very short-lasting in most patients and is of particular value for laryngoscopy and intubation. Should paralysis be prolonged, ventilation must be assisted until muscle function is fully restored. Suxamethonium normally produces a phase I (depolarizing) neuromuscular block. After high doses or prolonged use, the nature of the block changes to a phase II (non-depolarizing) block; this phase II block (also known as dual block) is associated with prolonged neuromuscular blockade and apnoea. [Mercy Ships note: **Alcuronium** is not on Mercy Ships list so WHO notes edited from here, **Atracurium** is available as a non-depolarizing muscle relaxant with duration of action of about 20-30 minutes]. Its effects may be rapidly reversed after surgery by the anticholinesterase neostigmine, provided atropine is given to prevent excessive autonomic activity. **Vecuronium**, a non-depolarizing muscle relaxant, has a shorter duration of action (20-30 minutes); it causes minimal adverse cardiovascular effects.

GENERIC (TRADE) NAME	CAT.	INDICATION/DOSE
Atracurium Besylate Inj 50mg/5ml (Tracrium) [Non-depolarising] °Fridge Item		Adult/Child <i>by rapid IV Inj</i> undiluted initially 300-600 micrograms/kg, then 100-200 micrograms/kg if needed; <i>IV infusion</i> 400-600 microgram/kg/hour at 5-10 micrograms/kg/minute, dilute 50mg with 95ml D5/NS to give a solution of 0.5mg/ml concentration.

Cont. next page

GENERIC (TRADE) NAME	CAT.	INDICATION/DOSE
<p>Glycopyrronium Bromide Inj 200 micrograms/ml (Robinul) [Glycopyrrolate] [Antimuscarinic]</p>		<p>Premed, intraoperative: <i>by IV/IM inj</i> Adult 200 micrograms (undiluted or IV diluted in D5/NS) to max dose of 400 micrograms, Child <i>by IV inj only</i> 4-8 micrograms/kg to max dose of 200 micrograms. Reversal of non-depolarising neuromuscular block: <i>By IV inj</i>, Adult 200 micrograms per 1 mg of neostigmine; Child 10 micrograms/kg with neostigmine 50 micrograms/kg (may be mixed with neostigmine in syringe).</p>
<p>Neostigmine Methylsulphate Inj 1mg/ml, 10ml (Prostigmine) [Anticholinesterase]</p>	<p>EML</p>	<p>Reversal of non-depolarizing block: <i>By slow IV inj</i> (undiluted over 1 minute), Adult 0.5-2.5 mg, followed if necessary by supplements of 500 micrograms to maximum total dose of 5 mg; Child 40 micrograms/kg (titrate using peripheral nerve stimulator). To reduce muscarinic effects give atropine sulphate <i>by IV inj</i> Adult 0.6-1.2 mg, Child 20 micrograms/kg, with or before neostigmine.</p> <p>Postoperative urinary retention: <i>By SC/IM inj</i>, Adult 500 micrograms to 1mg, (exclude mechanical obstruction, catheterization required if urine not passed within 1 hour); doses should be repeated every 3 hours for 5 doses after the bladder has been emptied.</p>

COMMENT/CAUTIONS:

- **Neostigmine** acts within 1 minute of IV injection and lasts for 20-30 minutes.
- **Neostigmine** must be used combined with atropine or glycopyrrolate to prevent muscarinic effects occurring.

13.06 PERI-OPERATIVE MEDICATION

WHO MODEL FORMULARY 2008 NOTES:

Pre-anaesthetic medication is often advisable prior to both conduction and general anaesthetic procedures [but not routine on Mercy Ships as patients may need to be walked to OR on board].

SEDATION. Sedatives improve the course of subsequent anaesthesia in apprehensive patients. Diazepam and promethazine are effective. **Diazepam** can be administered by mouth, by rectum, or by intravenous injection. **Promethazine**, which has antihistaminic and antiemetic properties as well as a sedative effect, is of particular value in children. [Mercy Ships note: Midazolam is available on Mercy Ships list and should be considered.]

ANALGESIA. A potent analgesic such as **morphine** (section 5.02) should be administered preoperatively to patients in severe pain or for analgesia during and after surgery.

FLUIDS. Fluid requirements must be assessed before, during and after major surgery. Replacement fluids should correspond as nearly as possible in volume and composition to those lost.

Blood transfusion is essential to restore oxygen-carrying capacity when more than 15% of the circulating blood volume is lost but should be avoided whenever screening for human immunodeficiency viruses and hepatitis B virus is impracticable.

Isotonic sodium chloride solution may be used for short-term volume replacement. Plasma expanders such as dextran 70 or polygeline may be useful (section 8.04). Provided renal function is maintained, fluid is most simply replaced by IV **sodium chloride solution** (sodium chloride 9mg/ml, 0.9%) or the more physiologically appropriate **compound solution of sodium lactate** (section 8.03).

In emergency cases, there is usually an existing fluid deficit, which must be assessed and corrected before surgery. Isotonic **glucose/sodium chloride** mixtures (most commonly glucose 4%/ sodium chloride 0.18%) are preferred in children to avoid the danger of sodium overload and hypoglycaemia. When fluids are administered IV for more than 24 hours, potassium chloride is required to prevent potassium depletion. In order to avoid serious arrhythmias (especially in impaired renal function) the required dose of potassium should be determined, whenever possible, by monitoring plasma concentrations of potassium.

GENERIC (TRADE) NAME	CAT.	INDICATION/DOSE
<p>Dantrolene Inj 20mg vial or Infusion 20mg/70ml (Dantrium)</p>		<p>Malignant hyperthermia: <i>By rapid IV injection</i>, 1mg/kg repeat as required until symptoms subside or to a cumulative max dose of 10mg/kg.</p> <p>Reconstitute 20mg vial in 60ml WFI, shake well to give 0.33mg/ml solution, keep at 15-30°C, protect from direct light and use within 6 hours following reconstitution.</p>
<p>Dehydrobenzperidol Inj 2.5mg/ml, 2ml (Droperidol)</p>		<p>Note. Use only in patients for whom other treatments are ineffective or inappropriate. Max recommended initial dose is 2.5mg <i>by slow IV/IM inj</i>. Additional 1.25mg doses must be administered with caution due to the potential risk for cardiac arrhythmias.</p> <p>Premedication: <i>By slow IV/IM inj</i> 2.5mg 30-60 minutes before surgery. See product leaflet and current guidelines for details. May be diluted to a convenient volume in D5/NS/RL.</p>
<p>Diazepam Tab 5mg Inj 5mg/ml, 2ml (Valium)</p> <p>Avoid IM route – unreliable absorption.</p>	<p>PS MSL IDA EML</p>	<p>Premedication: Adult & Child > 12yo, <i>by mouth</i> 2 hours before surgery, 5-10mg. Sedation: <i>By slow IV inj</i> undiluted over 2-4 minutes into a large vein just before surgery, Adult & Child > 12 yo, 200micrograms/kg.</p>
<p>Midazolam Inj 5mg/ml, 3ml (Dormicum/Hypnovel)</p> <p>Give dose 15 minutes before procedure. MONITOR for rapid respiratory depression; emergency resuscitation equipment must be available.</p>	<p>PS EML</p>	<p><i>By slow IV inj</i> undiluted or diluted in D5/NS/RL given over 2-5 minutes, Conscious sedation: Adult initially 2.5mg (elderly 0.5-1mg); usual range 3.5-7.5mg (elderly max 3.5mg); Child 6 month-5 yo initially 50-100 micrograms/kg, dose increased if necessary in small steps (max total dose 6mg); 6-12 yo initially 25-50 micrograms/kg, increase dose increase if needed in small steps (max total dose 10mg).</p>
<p>N/CD – Drugs subject to international control under the Single Convention on Narcotic Drugs (1961).</p>		
<p>PS – Drugs subject to international control under the Convention on Psychotropic Substances (1971).</p>		

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