






# MIDAZOLAM

<b>Indication</b>	<ul style="list-style-type: none"> <li>• Sedation during ventilation or procedure<sup>1</sup></li> <li>• Induction of anaesthesia prior to other anaesthetic agent use<sup>1</sup></li> <li>• Treatment of refractory seizures<sup>2</sup> and seizures at end of life</li> <li>• Management of symptoms at end of life (e.g. agitation, respiratory distress, dystonia)</li> </ul>		
<b>INTRAVENOUS</b>	<b>Presentation</b>	<ul style="list-style-type: none"> <li>• Ampoule 5 mg in 1 mL   5 mg in 5 mL</li> </ul>	
	<b>Dosage</b> (sedation, palliative care)	<ul style="list-style-type: none"> <li>• IV injection <ul style="list-style-type: none"> <li>○ 0.05–0.15 mg/kg (50–150 microgram/kg) 4 hourly<sup>3</sup></li> </ul> </li> <li>• IV standard infusion <ul style="list-style-type: none"> <li>○ Start at 0.01 mg/kg/hour (10 microgram/kg/hour)<sup>4</sup></li> <li>○ Titrate to response to a maximum of 0.06 mg/kg/hour (60 microgram/kg/hour)<sup>3</sup></li> </ul> </li> </ul>	
	<b>Dosage</b> (seizures)	<ul style="list-style-type: none"> <li>• IV loading dose<sup>2,3</sup> <ul style="list-style-type: none"> <li>○ 0.15 mg/kg (150 microgram/kg)</li> </ul> </li> <li>• IV maintenance infusion<sup>2,3</sup> <ul style="list-style-type: none"> <li>○ Start at 0.06 mg/kg/hour (60 microgram/kg/hour or 1 microgram/kg/minute)</li> <li>○ Titrate to response to a maximum of 0.4 mg/kg/hour (400 microgram/kg/hour or approximately 7 microgram/kg/minute)</li> </ul> </li> </ul>	
	<b>Preparation</b>	<ul style="list-style-type: none"> <li>• IV injection (5 mg in <u>5 mL</u> ampoule) <ul style="list-style-type: none"> <li>○ Nil required. Use undiluted</li> <li>○ <i>Concentration equal to 1 mg/mL (1000 microgram/mL) in solution</i></li> </ul> </li> </ul>	
		<ul style="list-style-type: none"> <li>• IV injection (5 mg in <u>1 mL</u> ampoule) <ul style="list-style-type: none"> <li>○ Draw up 5 mg (5000 microgram) and make up to 5 mL total volume with 0.9% sodium chloride<sup>5</sup></li> <li>○ <i>Concentration now equal to 1 mg/mL (1000 microgram/mL)</i></li> </ul> </li> </ul>	
		<ul style="list-style-type: none"> <li>• IV standard infusion <ul style="list-style-type: none"> <li>○ Draw up 1 mg/kg (1000 microgram/kg) and make up to 50 mL total volume with compatible fluid</li> <li>○ <i>Concentration now equal to 0.02 mg/kg/mL (20 microgram/kg/mL)</i></li> </ul> </li> <li>• IV infusion for seizure management <ul style="list-style-type: none"> <li>○ Refer to <i>Quick Guide</i> (below) for increased concentration preparations</li> </ul> </li> </ul>	
<b>Administration</b>	<ul style="list-style-type: none"> <li>• IV injection <ul style="list-style-type: none"> <li>○ Draw up prescribed dose</li> <li>○ IV injection over 3–5 minutes<sup>1,5,6</sup> (do not inject rapidly)</li> </ul> </li> <li>• IV infusion <ul style="list-style-type: none"> <li>○ Prime the infusion line and administer at prescribed rate via syringe driver pump</li> <li>○ <i>Standard infusion of 0.02 mg/kg mL (20 microgram/kg/mL) infused at 0.5 mL/hour equals 0.01 mg/kg/hour (10 microgram/kg/hour)</i></li> </ul> </li> </ul>		

<b>IM</b>	<b>Presentation</b>	<ul style="list-style-type: none"> <li>• Ampoule 5 mg in 1 mL   5 mg in 5 mL</li> </ul>	
	<b>Indication</b>	<ul style="list-style-type: none"> <li>• Only if IV route not available</li> </ul>	
	<b>Dosage</b>	<ul style="list-style-type: none"> <li>• 0.05–0.15 mg/kg (50–150 microgram/kg) every 4 hours if required</li> </ul>	
	<b>Preparation</b>	<ul style="list-style-type: none"> <li>• 5 mg in <u>5 mL</u> ampoule                             <ul style="list-style-type: none"> <li>○ Nil required. Use undiluted</li> <li>○ <i>Concentration equal to 1 mg/mL (1000 microgram/mL) in solution</i></li> </ul> </li> <li>• 5 mg in <u>1 mL</u> ampoule                             <ul style="list-style-type: none"> <li>○ Draw up 5 mg (5000 microgram) and make up to 5 mL total volume with 0.9% sodium chloride<sup>5</sup></li> <li>○ <i>Concentration now equal to 1 mg/mL (1000 microgram/mL)</i></li> </ul> </li> </ul>	
	<b>Administration</b>	<ul style="list-style-type: none"> <li>• Intramuscular injection into thickest part of the vastus lateralis in the anterolateral thigh (maximum 0.5 mL per site)<sup>7</sup></li> </ul>	

<b>NASAL</b>	<b>Presentation</b>	<ul style="list-style-type: none"> <li>• Ampoule 5 mg in 1 mL   5 mg in 5 mL</li> </ul>	
	<b>Indication</b>	<ul style="list-style-type: none"> <li>• Intubation when no IV access (once only)</li> <li>• All listed indications including seizures and palliative care</li> </ul>	
	<b>Dosage</b>	<ul style="list-style-type: none"> <li>• 0.1–0.3 mg/kg (100–300 microgram/kg)<sup>4</sup></li> </ul>	
	<b>Preparation</b>	<ul style="list-style-type: none"> <li>• 5 mg in <u>5 mL</u> ampoule                             <ul style="list-style-type: none"> <li>○ Nil required. Use undiluted</li> <li>○ <i>Concentration equal to 1 mg/mL (1000 microgram/mL) in solution</i></li> </ul> </li> <li>• 5 mg in <u>1 mL</u> ampoule                             <ul style="list-style-type: none"> <li>○ Draw up 5 mg (5000 microgram) and make up to 5 mL total volume with 0.9% sodium chloride<sup>5</sup></li> <li>○ <i>Concentration now equal to 1 mg/mL (1000 microgram/mL)</i></li> </ul> </li> </ul>	
	<b>Administration</b>	<ul style="list-style-type: none"> <li>• Draw up prescribed dose</li> <li>• Instil into alternating nares over 15 seconds</li> </ul>	

<b>BUCCAL</b>	<b>Presentation</b>	<ul style="list-style-type: none"> <li>• Ampoule 5 mg in 1 mL   5 mg in 5 mL</li> </ul>	
	<b>Indication</b>	<ul style="list-style-type: none"> <li>• All listed indications including seizures and palliative care</li> </ul>	
	<b>Dosage</b>	<ul style="list-style-type: none"> <li>• Start at 0.2–0.3 mg/kg (200–300 microgram/kg)<sup>1,6</sup> every 4–6 hours</li> <li>• Adjust according to clinical need</li> </ul>	
	<b>Preparation</b>	<ul style="list-style-type: none"> <li>• 5 mg in <u>5 mL</u> ampoule                             <ul style="list-style-type: none"> <li>○ Nil required. Use undiluted</li> <li>○ <i>Concentration equal to 1 mg/mL (1000 microgram/mL) in solution</i></li> </ul> </li> <li>• 5 mg in <u>1 mL</u> ampoule                             <ul style="list-style-type: none"> <li>○ Draw up 5 mg (5000 microgram) and make up to 5 mL total volume with 0.9% sodium chloride<sup>5</sup></li> <li>○ <i>Concentration now equal to 1 mg/mL (1000 microgram/mL)</i></li> </ul> </li> </ul>	
	<b>Administration</b>	<ul style="list-style-type: none"> <li>• Draw up prescribed dose</li> <li>• Trickle dose from syringe between gum and cheek</li> </ul>	

<b>SUBCUT</b>	<b>Presentation</b>	<ul style="list-style-type: none"> <li>• Ampoule 5 mg in 1 mL   5 mg in 5 mL</li> </ul>	
	<b>Indication</b>	<ul style="list-style-type: none"> <li>• Palliative care</li> </ul>	
	<b>Dosage</b>	<ul style="list-style-type: none"> <li>• Subcutaneous injection                             <ul style="list-style-type: none"> <li>○ Start at 0.1 mg/kg (100 microgram/kg) every 4–6 hours<sup>8</sup></li> <li>○ Adjust according to clinical need (can be as frequent as every 1–2 hours)</li> </ul> </li> </ul>	
		<ul style="list-style-type: none"> <li>• Subcutaneous continuous infusion                             <ul style="list-style-type: none"> <li>○ Start at 0.015 mg/kg/hour (15 microgram/kg/hour)</li> <li>○ Adjust according to clinical need</li> </ul> </li> </ul>	
	<b>Preparation</b>	<ul style="list-style-type: none"> <li>• 5 mg in <u>5 mL</u> ampoule                             <ul style="list-style-type: none"> <li>○ Nil required. Use undiluted</li> <li>○ <i>Concentration equal to 1 mg/mL (1000 microgram/mL) in solution</i></li> </ul> </li> </ul>	
<ul style="list-style-type: none"> <li>• 5 mg in <u>1 mL</u> ampoule                             <ul style="list-style-type: none"> <li>○ Draw up 5 mg (5000 microgram) and make up to 5 mL total volume with 0.9% sodium chloride</li> <li>○ <i>Concentration now equal to 1 mg/mL (1000 microgram/mL)</i></li> </ul> </li> </ul>			
<b>Administration</b>	<ul style="list-style-type: none"> <li>• Subcutaneous injection                             <ul style="list-style-type: none"> <li>○ Draw up prescribed dose and administer into thigh or abdomen</li> </ul> </li> </ul>		
	<ul style="list-style-type: none"> <li>• Subcutaneous continuous infusion                             <ul style="list-style-type: none"> <li>○ Prime the infusion line and administer at prescribed rate via syringe driver pump</li> </ul> </li> </ul>		

<b>Special considerations</b>	<ul style="list-style-type: none"> <li>• High risk medication. Errors may result in significant harm                             <ul style="list-style-type: none"> <li>○ Available in three different concentrations. Check product selection carefully</li> <li>○ Consider drawing IV injection dose from standard infusion solution to avoid accidental overdose from decimal point related errors (standard infusion solution: 1 mL=20 microgram/kg)</li> </ul> </li> <li>• Contraindication: glaucoma<sup>3</sup></li> <li>• Caution: hepatic impairment<sup>1</sup></li> <li>• If prescribed for palliative care:                             <ul style="list-style-type: none"> <li>○ Consult with Paediatric Palliative Care Team (1800 249 648)</li> <li>○ Other subcutaneous delivery devices requiring different preparation may be appropriate (e.g. Niki T34)</li> </ul> </li> <li>• Infusions may be prescribed as standard, double, quadruple or greater strength (e.g. if higher dosages indicated for seizure management)                             <ul style="list-style-type: none"> <li>○ Refer below to Quick guide: midazolam IV infusion concentrations</li> </ul> </li> <li>• IM route only if IV route not available                             <ul style="list-style-type: none"> <li>○ Onset of action 10–20 minutes IM versus 3–5 minute IV</li> <li>○ Painful injection</li> </ul> </li> <li>• Intranasal dosing for intubation once only as acidity of solution can damage nasal mucosa</li> <li>• UAC route: Only for infusion. Discuss with neonatologist/paediatrician prior to use</li> </ul>
	<b>Monitoring</b>
<b>Compatibility</b>	<ul style="list-style-type: none"> <li>• Fluids                             <ul style="list-style-type: none"> <li>○ 5% glucose<sup>5</sup>, 10% glucose<sup>5</sup>, 0.9% sodium chloride<sup>5</sup></li> </ul> </li> <li>• Y-Site                             <ul style="list-style-type: none"> <li>○ amikacin<sup>5</sup>, amiodarone<sup>5</sup>, atracurium<sup>5</sup>, calcium gluconate<sup>5</sup>, caspofungin<sup>5</sup>, cefazolin<sup>5</sup>, cefotaxime<sup>5</sup>, ciprofloxacin<sup>5</sup>, cisatracurium<sup>5</sup>, clindamycin<sup>5</sup>, digoxin<sup>5</sup>, dopamine<sup>5</sup>, erythromycin<sup>5</sup>, esmolol<sup>5</sup>, fentanyl<sup>5</sup>, fluconazole<sup>5</sup>, gentamicin<sup>5</sup>, glyceryl trinitrate<sup>5</sup>, haloperidol<sup>5</sup>, linezolid<sup>5</sup>, metronidazole<sup>5</sup>, milrinone<sup>5</sup>, morphine<sup>5</sup>, noradrenaline (norepinephrine)<sup>5</sup>, paracetamol<sup>5</sup>, potassium chloride<sup>5</sup>, ranitidine<sup>5</sup>, sodium nitroprusside<sup>5</sup>, tobramycin<sup>5</sup>, vancomycin<sup>5</sup>, vecuronium<sup>5</sup></li> </ul> </li> </ul>

<b>Incompatibility</b>	<ul style="list-style-type: none"> <li>• PN and fat emulsion: co-infusion with midazolam not recommended (evidence limited). If unavoidable, seek pharmacist advice first, filter infusion and flush before and after</li> <li>• Fluids <ul style="list-style-type: none"> <li>○ No information<sup>5</sup></li> </ul> </li> <li>• Drugs <ul style="list-style-type: none"> <li>○ Aciclovir<sup>5</sup>, albumin<sup>5</sup>, amoxicillin<sup>5</sup>, ampicillin<sup>5</sup>, azathioprine<sup>5</sup>, azithromycin<sup>5</sup>, cefepime<sup>5</sup>, ceftazidime<sup>5</sup>, dexamethasone<sup>5</sup>, epoetin alfa<sup>5</sup>, ertapenem<sup>5</sup>, esomeprazole<sup>5</sup>, flucloxacillin<sup>5</sup>, foscarnet<sup>5</sup>, furosemide (frusemide)<sup>5</sup>, hydrocortisone<sup>5</sup>, imipenem<sup>5</sup>, indometacin<sup>5</sup>, omeprazole<sup>5</sup>, phenobarbital (phenobarbitone)<sup>5</sup>, sodium bicarbonate<sup>5</sup>, trimethoprim-sulfamethoxazole (co-trimoxazole)<sup>5</sup></li> </ul> </li> </ul>
<b>Interactions</b>	<ul style="list-style-type: none"> <li>• Concomitant use with other sedative, hypnotic, or CNS-depressant drugs results in increased sedation<sup>1</sup></li> </ul>
<b>Stability</b>	<ul style="list-style-type: none"> <li>• Ampoule <ul style="list-style-type: none"> <li>○ Store below 25 °C. Protect from light<sup>5</sup></li> <li>○ Single patient use, discard remainder</li> <li>○ Solution is clear and colourless to light yellow<sup>5</sup></li> </ul> </li> <li>• Infusion<sup>5</sup> <ul style="list-style-type: none"> <li>○ Change solution and lines every 24 hours</li> </ul> </li> </ul>
<b>Side effects</b>	<ul style="list-style-type: none"> <li>• Circulatory: hypotension<sup>1</sup> (especially with loading doses)</li> <li>• Digestive: gastrointestinal disturbance, vomiting<sup>1</sup></li> <li>• Integumentary: Nasal route reported to produce burning sensation<sup>9</sup></li> <li>• Nervous: over-sedation and drowsiness<sup>1</sup> seizure-like myoclonus reported<sup>3</sup></li> <li>• Respiratory: respiratory depression<sup>1</sup>, drowsiness<sup>1</sup></li> </ul>
<b>Actions</b>	<ul style="list-style-type: none"> <li>• Short acting benzodiazepine with rapid onset of action<sup>3</sup></li> <li>• Sedative and anticonvulsant properties related to GABA accumulation and occupation of benzodiazepine receptor<sup>3</sup></li> <li>• Flumazenil (benzodiazepine antagonist) is used to reverse respiratory depression<sup>5</sup> <ul style="list-style-type: none"> <li>○ Avoid use in palliative care if possible</li> </ul> </li> </ul>
<b>Abbreviations</b>	CNS: central nervous system, CVL: central venous line, GABA: gamma-aminobutyric acid, IM: intramuscular, IV: intravenous, UAC: umbilical artery catheter
<b>Keywords</b>	Anticonvulsant, sedation, benzodiazepine, palliative care

### Quick Guide: midazolam IV infusion concentrations

Draw up midazolam dose	Make up to total volume (mL)	Concentration (microgram/kg/mL)	Infusion rate (mL/hour)	Delivers (microgram/kg/hour)
1 mg/kg (1000 microgram/kg)	50 mL	20 microgram/kg/mL	@ 0.5 mL/hour	10 microgram/kg/hour
2 mg/kg (2000 microgram/kg)	50 mL	40 microgram/kg/mL	@ 0.5 mL/hour	20 microgram/kg/hour
4 mg/kg (4000 microgram/kg)	50 mL	80 microgram/kg/mL	@ 0.5 mL/hour	40 microgram/kg/hour
8 mg/kg (8000 microgram/kg)	50 mL	160 microgram/kg/mL	@ 0.5 mL/hour	80 microgram/kg/hour

The Queensland Clinical Guideline *Neonatal Medicines* is integral to and should be read in conjunction with this monograph. Refer to the disclaimer. Destroy all printed copies of this monograph after use.

## References

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## Document history

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