## LORazepam

### Brand names
Ativan, generics

### Medication error potential
High-alert medication associated an increased risk of causing significant patient harm if an error occurs.\(^1\)

Look-alike, sound-alike drug names. Confusion with ALPRAZolam, clonazePAM, diazePAM, loperamide, loratadine, midazolam, oxazepam, temazepam, and zolpidem have been reported. Confusion has also been noted between Ativan and ALPRAZolam, Ambien, Antivert, Artane, Atarax, and clonazePAM. Confusion with ALPRAZolam has resulted in patient harm.\(^2\)

ISMP recommends the following tall man letters (not FDA approved): LORazepam.\(^3\)

### Contraindications and warnings
**Contraindications:** Should not be used in patients with (1) a known sensitivity to benzodiazepines or its vehicles (polyethylene glycol, propylene glycol, and benzyl alcohol); (2) acute narrow-angle glaucoma; (3) sleep apnea syndrome; and (4) severe respiratory insufficiency (except in those patients requiring relief of anxiety and/or diminished recall of events while being mechanically ventilated).\(^4\) (See the Infusion-Related Cautions section.)

### Infusion-related cautions
Respiratory depression may occur; hence, artificial ventilation equipment should be available. Inadvertent intra-arterial injection can cause vasospasm that may produce gangrene and subsequent amputation.\(^6\) Infuse into a patent and running IV. If a patient complains of pain during injection, the infusion should be stopped, and the IV site should be inspected.

### Dosage
Resuscitative equipment, including ones necessary to support respiration, should be readily available. Flumazenil should be available for reversal. (See Antidote in the Comments section and see the Flumazenil monograph.)

**Antiemetic therapy, adjunct to:** Single doses of 0.01 mg/kg have been used preoperatively for nausea associated with strabismus surgery\(^5\); however, single doses of at least 0.04 mg/kg (maximum 3 mg/dose) were required for emesis associated with chemotherapy.\(^6,7\) Multiple doses of 0.04–0.08 mg/kg (maximum 2 mg/dose) may be given q 6 hr PRN.\(^7\)

**Procedural sedation, adjunct to**\(^8,9\): Many consider midazolam the benzodiazepine of choice for procedural sedation.\(^10-13\) (See the Midazolam monograph.) If lorazepam is used give 0.05 mg/kg (0.01–0.1 mg/kg) q 4–8 hr\(^9\) not to exceed 2 mg/dose.\(^4,8\) For premedication therapy, give first IV dose 15–20 minutes before procedure and first IM dose 2 hours before procedure.

**Busulfan-associated seizures:** 0.02–0.05 mg/kg (up to 2 mg/dose) given 30 minutes before each dose of busulfan.\(^15,16\) Continue every 6 hours for 4 additional doses after the last dose of busulfan.\(^15,16\) 0.1 mg/kg/day (up to 2 mg/day) has been given by continuous infusion for 5.5 days.\(^14\) The infusion was started 12 hours before busulfan and was discontinued 24 hours after the last dose of busulfan.\(^14\)

**Sedation with mechanical ventilation:** Use lowest effective dose. 0.025–0.05 mg/kg (up to 2 mg/dose) given as an intermittent infusion q 2–4 hr or by continuous infusion, at a rate of 0.025 mg/kg/hr (up to 2 mg/hr).\(^11\) (See the Additives and Comments sections if given by continuous infusion.)

**Seizures (acute, nonstatus, or status epilepticus)**\(^52-55\)

**Neonates:** In a recent survey of neonatologists, 82% (n = 480) would give phenobarbital as the preferred anticonvulsant.\(^17\) If a benzodiazepine is required, midazolam should be used as it does not contain propylene glycol or benzyl alcohol. (See the Midazolam monograph.) If lorazepam is used, refer to Pharmacokinetic Considerations and Pharmacodynamic Considerations in the Comments section and Appendix C.\(^18-20\)

**Infants and children:** 0.1 mg/kg\(^18-20,22-25\) up to 4 mg/dose.\(^23\) If seizures continue after 10–15 minutes give 0.05 mg/kg; if there is no response after 10–15 minutes repeat 0.05 mg/kg.\(^22-24\)
### Dose adjustment in organ dysfunction

No adjustment in renal dysfunction due to lorazepam itself.\(^\text{4,26}\) Patients receiving large doses for a prolonged time may accumulate one of the additives (i.e., propylene glycol) and experience toxicity.\(^\text{27,28}\) (See the Comments section and Appendix C.) Not metabolized by cytochrome oxidation, thus liver disease should not affect metabolic clearance.\(^\text{4}\) Use cautiously in patients with combined renal and hepatic dysfunction.\(^\text{4}\) Larger doses may be required in patients on extracorporeal membrane oxygenation (ECMO).\(^\text{33}\) (See Delivery System Issues in the Preparation and Delivery section.)

### Maximum dosage

4 mg/dose.\(^\text{11,23}\) Doses as large as 0.4 mg/kg have been safely administered.\(^\text{5,30}\) A 14-year-old with refractory seizures who had been on chronic lorazepam was given 0.25 mg/kg/dose to a cumulative dose of 186 mg (4.3 mg/kg) over 24 hours.\(^\text{31}\) Patients on benzodiazepines prior to admission may require larger doses for control.

### Additives

Contains benzyl alcohol 2% and 40% propylene glycol.\(^\text{32}\) (See Appendix C for specific information about benzyl alcohol and propylene glycol toxicity.)

### Suitable diluents

D5W, NS, SW\(^\text{4}\)

### Maximum concentration

Although 2 mg/mL and 4 mg/mL\(^\text{23,25}\) have been given, the manufacturer recommends dilution immediately prior to administration by using an equal volume of compatible diluent (≤1 mg/mL).\(^\text{4,32}\)

### Preparation and delivery

Parenteral products should be visually inspected for particulate matter and discoloration before use. Refer to appropriate references for more information on compatibility with other drugs and solutions; compatibility following Y-site delivery, and suggested storage and extended stability.\(^\text{32}\)

**Stability:** Store in refrigerator.\(^\text{4}\) When kept at room temperature or used in emergency transport vehicles, lorazepam became unstable within weeks (e.g., 60 days).\(^\text{50,51}\) A follow-up study by the same group noted significant degradation over 120 days.\(^\text{56}\) If discoloration is noted do not use.

**Delivery system issues:** Larger doses may be required in patients on extracorporeal membrane oxygenation since 50% of a dose may be extracted by the PVC tubing and the membrane oxygenator during bypass.\(^\text{33}\)

**Compatibility:** See Appendix D or other appropriate resources for PN compatibility information.

**Photosensitivity:** Protect commercial product from light until use.\(^\text{4}\)

### IV push

Not to exceed 2 mg/min\(^\text{4,25}\) or 0.05 mg/kg over 2–5 minutes.\(^\text{18}\)

### Intermittent infusion

Generally, not administered by this method. Is given intermittently for treatment of busulfan-associated seizures.

### Continuous infusion

0.2 mg/mL has been administered in adults\(^\text{34-39}\); however, little information is available in pediatric patients.\(^\text{13,14}\) Midazolam is preferred when continuous infusion is needed due to propylene glycol accumulation. (See the Comments section.)

### Other routes of administration

Midazolam is the benzodiazepine of choice for IM and prehospital administration.\(^\text{39}\) (See the Midazolam monograph.) Undiluted lorazepam can be given deep into a muscle, but it may cause pain at the injection site, a burning sensation, or observed redness.\(^\text{4}\)