

## **SUMMARY OF PRODUCT CHARACTERISTICS**

### **1 NAME OF THE MEDICINAL PRODUCT**

Midazolam 10 mg oromucosal solution

### **2 QUALITATIVE AND QUANTITATIVE COMPOSITION**

Midazolam 10 mg oromucosal solution

Each pre-filled oral syringe contains 10 mg midazolam (as hydrochloride) in 2 ml solution

### **3 PHARMACEUTICAL FORM**

Oromucosal solution

Clear, colourless to yellowish solution

pH 2.9 to 3.7

### **4 CLINICAL PARTICULARS**

#### **4.1 Therapeutic indications**

Treatment of prolonged, acute, convulsive seizures in infants, toddlers, children and adolescents (from 3 months to < 18 years).

Midazolam must only be used by parents/carers where the patient has been diagnosed to have epilepsy.

For infants between 3-6 months of age treatment should be in a hospital setting where monitoring is possible and resuscitation equipment is available. See section 4.2.

#### **4.2 Posology and method of administration**

## Posology

Standard doses are indicated below:

<b>Age range</b>	<b>Dose</b>	<b>Label colour</b>
3 to 6 months hospital setting	2.5 mg	Yellow
> 6 months to < 1 year	2.5 mg	Yellow
1 year to < 5 years	5 mg	Blue
5 years to < 10 years	7.5 mg	Purple
10 years to < 18 years	10 mg	Orange

Carers should only administer a single dose of midazolam. If the seizure has not stopped within 10 minutes after administration of midazolam, emergency medical assistance must be sought and the empty syringe given to the healthcare professional to provide information on the dose received by the patient.

A second or repeat dose when seizures re-occur after an initial response should not be given without prior medical advice (see section 5.2).

### Special populations

#### *Renal impairment*

No dose adjustment is required, however, Midazolam should be used with caution in patients with chronic renal failure as elimination of midazolam may be delayed and the effects prolonged. (see section 4.4)

#### *Hepatic impairment*

Hepatic impairment reduces the clearance of midazolam with a subsequent increase in terminal half-life. Therefore, the clinical effects may be stronger and prolonged, hence careful monitoring of the clinical effects and vital signs is recommended following administration of midazolam in patients with hepatic impairment (see section 4.4).

Midazolam is contraindicated in patients with severe hepatic impairment (see section 4.3).

#### *Paediatric population*

The safety and efficacy of midazolam in children aged 0 to 3 months has not been established. No data are available.

### Method of administration

Midazolam is for oromucosal use. The full amount of solution should be inserted slowly into the space between the gum and the cheek. Laryngo-tracheal insertion should be avoided to prevent accidental aspiration of the solution. If necessary (for larger volumes and/or smaller patients), approximately half the dose should be given slowly into one side of the mouth, then the other half given slowly into the other side.

For detailed instructions on how to administer the medicinal product, see section 6.6.

### Precautions to be taken before handling or administering the medicinal product

No needle, intravenous tubing or any other device for parenteral administration should be attached to the oral syringe.

Midazolam is not for intravenous use.

The oral syringe cap should be removed before use to avoid risk of choking.

### **4.3 Contraindications**

Hypersensitivity to the active substance, benzodiazepines or to any of the excipients listed in section 6.1

Myasthenia gravis

Severe respiratory insufficiency

Sleep apnoea syndrome

Severe hepatic impairment

### **4.4 Special warnings and precautions for use**

#### Respiratory insufficiency

Midazolam should be used with caution in patients with chronic respiratory insufficiency because midazolam may further depress respiration.

#### Paediatric patients aged 3 to 6 months

Given the higher metabolite to parent drug ratio in younger children, a delayed respiratory depression as a result of high active metabolite concentrations in the 3-6 months age group cannot be excluded. Therefore, the use of Midazolam in the 3-6 month age group should be limited for use only under the supervision of a health care professional where resuscitation equipment is available and where respiratory function can be monitored and equipment for respiratory assistance, if needed, is available.

#### Altered elimination of midazolam

Midazolam should be used with caution in elderly patients and in patients with chronic renal failure, impaired hepatic or cardiac function. Midazolam may accumulate in patients with chronic renal failure or impaired hepatic function whilst in patients with impaired cardiac function it may cause decreased clearance of midazolam.

#### Concomitant use with other benzodiazepines

Debilitated patients are more prone to the central nervous system (CNS) effects of benzodiazepines and, therefore, lower doses may be required.

Medical history of alcohol or drug abuse Midazolam should be avoided in patients with a medical history of alcohol or drug abuse.

#### Amnesia

Midazolam may cause anterograde amnesia.

## Excipients

### Sodium

This medicine contains less than 1 mmol sodium (23 mg) per oral syringe, that is to say essentially 'sodium-free'.

## **4.5 Interaction with other medicinal products and other forms of interaction**

Midazolam is metabolized by CYP3A4. Inhibitors and inducers of CYP3A4 have the potential to respectively increase and decrease the plasma concentrations and, subsequently, the effects of midazolam thus requiring dose adjustments accordingly. Pharmacokinetic interactions with CYP3A4 inhibitors or inducers are more pronounced for oral as compared to oromucosal or parenteral midazolam as CYP3A4 enzymes are also present in the upper gastro-intestinal tract. After oromucosal administration, only systemic clearance will be affected. After a single dose of oromucosal midazolam, the consequence on the maximal clinical effect due to CYP3A4 inhibition will be minor while the duration of effect may be prolonged. Hence, a careful monitoring of the clinical effects and vital signs is recommended during the use of midazolam with a CYP3A4 inhibitor even after a single dose.

### Anaesthetics and narcotic analgesics

Fentanyl may reduce midazolam clearance.

### Antiepileptics

Co-administration with midazolam may cause enhanced sedation or respiratory or cardiovascular depression. Midazolam may interact with other hepatically metabolised medicinal products, e.g. phenytoin, causing potentiation.

### Calcium-channel blockers

Diltiazem and verapamil have been shown to reduce the clearance of midazolam and other benzodiazepines and may potentiate their actions.

### Ulcer-healing medicinal products

Cimetidine, ranitidine and omeprazole have been shown to reduce the clearance of midazolam and other benzodiazepines and may potentiate their actions.

### Xanthines

Metabolism of midazolam and other benzodiazepines is accelerated by xanthines.

### Dopaminergic medicinal products

Midazolam may cause inhibition of levodopa.

### Muscle relaxants

E.g. baclofen. Midazolam may cause potentiation of muscle relaxants, with increased CNS depressant effects.

### Nabilone

Co-administration with midazolam may cause enhanced sedation or respiratory and cardiovascular depression.

### Medicinal products that inhibit CYP3A4

Medicinal product interactions following oromucosal administration of midazolam are likely to be similar to those observed after intravenous midazolam rather than oral administration.

#### *Food*

Grapefruit juice reduces the clearance of midazolam and potentiates its action.

#### *Azole antifungals*

Ketoconazole increased the plasma concentrations of intravenous midazolam by 5-fold while the terminal half-life increased by about 3-fold.

Voriconazole increased the exposure of intravenous midazolam by 3-fold whereas its elimination half-life increased by about 3-fold.

Fluconazole and itraconazole both increased the plasma concentrations of intravenous midazolam by 2 to 3-fold associated with an increase in terminal half-life by 2.4-fold for itraconazole and 1.5-fold for fluconazole.

Posaconazole increased the plasma concentrations of intravenous midazolam by about 2-fold.

#### *Macrolide antibiotics*

Erythromycin resulted in an increase in the plasma concentrations of intravenous midazolam by about 1.6 to 2 –fold associated with an increase of the terminal half-life of midazolam by 1.5 to 1.8-fold.

Clarithromycin increased the plasma concentrations of intravenous midazolam by up to 2.5-fold associated with an increase in terminal half-life by 1.5 to 2-fold.

#### *HIV Protease inhibitors*

Co-administration with protease inhibitors (e.g. Saquinavir and other HIV protease inhibitors) may cause a large increase in the concentration of midazolam. Upon co-administration with ritonavir-boosted lopinavir, the plasma concentrations of intravenous midazolam increased by 5.4-fold, associated with a similar increase in terminal half-life.

#### *Calcium-channel blockers*

A single dose of diltiazem increased the plasma concentrations of intravenous midazolam by about 25% and the terminal half-life was prolonged by 43%.

#### *Various medicinal products*

Atorvastatin showed a 1.4-fold increase in plasma concentrations of intravenous midazolam compared to control group.

#### Medicinal products that induce CYP3A4

##### *Rifampicin*

7 days of 600 mg once daily decreased the plasma concentrations of intravenous midazolam by about 60%. The terminal half-life decreased by about 50-60%.

##### *Herbs*

St John's Wort decreased plasma concentrations of midazolam by about 20-40% associated with a decrease in terminal half-life of about 15-17%.

Depending on the specific St John's Wort extract, the CYP3A4-inducing effect may vary.

#### Pharmacodynamic Drug-Drug Interactions (DDI)

The co-administration of midazolam with other sedative/hypnotic medicinal products and CNS depressants, including alcohol, is likely to result in enhanced sedation and respiratory depression.

Examples include opiate derivatives (used as analgesics, antitussives or substitutive treatments), antipsychotics, other benzodiazepines used as

anxiolytics or hypnotics, barbiturates, propofol, ketamine, etomidate; sedative antidepressants, non-recent H1-antihistamines and centrally acting antihypertensive medicinal products.

Alcohol (including alcohol-containing medicinal products) may markedly enhance the sedative effect of midazolam. Alcohol intake should be strongly avoided in case of midazolam administration (see section 4.4).

Midazolam decreases the minimum alveolar concentration (MAC) of inhalation anaesthetics.

The effect of CYP3A4 inhibitors may be larger in infants since part of the oromucosal dose is probably swallowed and absorbed in the gastro-intestinal tract.

## **4.6 Fertility, pregnancy and lactation**

### Pregnancy

There are no or limited amount of data from the use of midazolam in pregnant women. Animal studies do not indicate a teratogenic effect with respect to reproductive toxicity, but foetotoxicity has been observed in humans as with other benzodiazepines. No data on exposed pregnancies are available for the first two trimesters of pregnancy.

The administration of high doses of midazolam in the last trimester of pregnancy or during labour has been reported to produce maternal or foetal adverse reactions (risk of aspiration of fluids and stomach contents during labour in the mother, irregularities in the foetal heart rate, hypotonia, poor suckling, hypothermia and respiratory depression in the new-born infant).

Midazolam may be used during pregnancy if clearly necessary. The risk for new-born infants should be taken into account in the event of administration of midazolam in the third trimester of pregnancy.

### Breast-feeding

Midazolam is excreted in low quantities (0.6%) in human milk. As a result it may not be necessary to stop breast feeding following a single dose of midazolam.

### Fertility

Animal studies did not show an impairment of fertility (see section 5.3).

## **4.7 Effects on ability to drive and use machines**

This medicine can impair cognitive function and can affect a patient's ability to drive safely. This class of medicine is in the list of drugs included in regulations under 5a of the Road Traffic Act 1988. When prescribing this medicine, patients should be told:

- The medicine is likely to affect your ability to drive
- Do not drive until you know how the medicine affects you
- It is an offence to drive while under the influence of this medicine

- However, you would not be committing an offence (called ‘statutory defence’) if:
  - The medicine has been prescribed to treat a medical or dental problem and
  - You have taken it according to the instructions given by the prescriber and in the information provided with the medicine and
  - It was not affecting your ability to drive safely”

Midazolam has a major influence on the ability to drive and use machines.

Sedation, amnesia, impaired attention and impaired muscular function may adversely affect the ability to drive, ride a bicycle or use machines. After receiving midazolam, the patient should be warned not to drive a vehicle or operate a machine until completely recovered.

## 4.8 Undesirable effects

### Summary of the safety profile

Published clinical studies show that oromucosal midazolam was administered to approx 443 children and 224 adults with seizures. Respiratory depression occurs at a rate of up to 5%, although this is a known complication of convulsive seizures as well as being related to midazolam use. One episode of pruritus was possibly attributed to the use of buccal midazolam.

### Tabulated list of adverse reactions

The table below lists the adverse reactions reported to occur when oromucosal midazolam was administered in clinical studies and post-marketing experience.

The frequency of adverse reactions is classified as follows:

Common:  $\geq 1/100$  to  $< 1/10$

Uncommon:  $\geq 1/1,000$  to  $< 1/100$

Very rare:  $< 1/10,000$  Not known: cannot be estimated from the available data

Within each frequency grouping, adverse reactions are presented in order of decreasing seriousness:

System Organ Class	Frequency: Adverse Drug Reaction
Psychiatric disorders	Very rare: Aggression **, agitation **, anger **, confusional state **, euphoric mood **, hallucination **, hostility **, movement disorder **, physical assault **
Nervous system disorders	Common: Sedation, somnolence, depressed levels of consciousness Respiratory depression Very rare: Anterograde amnesia **, ataxia **, dizziness **, headache **, seizure **, paradoxical reactions **

Cardiac disorders	Very rare: Bradycardia **, cardiac arrest **, hypotension **, vasodilatation **
Respiratory, thoracic and mediastinal disorders	Very rare: Apnoea **, dyspnoea **, laryngospasm **, respiratory arrest **
Gastrointestinal disorders	Common: Nausea and vomiting Very rare: Constipation **, dry mouth **
Skin and subcutaneous tissue disorders	Uncommon: Pruritus, rash and urticarial Not known: Angioedema *
General disorders and administration site conditions	Very rare: Fatigue **, hiccups **
Immune system disorders	Not known: Anaphylactic reaction*

*\*\*These adverse reactions have been reported to occur when midazolam is injected in children and/or adults, which may be of relevance to oromucosal administration.*

*\* ADR identified from post-marketing experience.*

#### Description of selected adverse reactions

An increased risk for falls and fractures has been recorded in elderly benzodiazepine users.

Life-threatening incidents are more likely to occur in those with pre-existing respiratory insufficiency or impaired cardiac function, particularly when a high dosage is administered (see section 4.4).

#### Reporting of suspected adverse reactions

Reporting suspected adverse reactions after authorisation of the medicinal product is important. It allows continued monitoring of the benefit/risk balance of the medicinal product. Healthcare professionals are asked to report any suspected adverse reactions via the Yellow Card Scheme Website:

[www.mhra.gov.uk/yellowcard](http://www.mhra.gov.uk/yellowcard) or search for MHRA Yellow Card in the Google Play or Apple App Store.

## **4.9 Overdose**

### Symptoms

Midazolam overdose can present a threat to life if the patient has pre-existing respiratory or cardiac insufficiency, or when combined with other CNS depressants (including alcohol).

Overdose of benzodiazepines is usually manifested by degrees of central nervous system depression ranging from drowsiness to coma. In mild cases, symptoms

include drowsiness, mental confusion and lethargy, in more serious cases, symptoms may include ataxia, hypotonia, hypotension, respiratory depression, rarely coma and very rarely death.

### Management

In the management of overdose with any medicinal product, it should be borne in mind that multiple agents may have been taken.

Following overdose with oral midazolam, vomiting should be induced (within one hour) if the patient is conscious or gastric lavage undertaken with the airway protected if the patient is unconscious. If there is no advantage in emptying the stomach, activated charcoal should be given to reduce absorption. Special attention should be paid to respiratory and cardiovascular functions in intensive care.

Flumazenil may be useful as an antidote.

## **5 PHARMACOLOGICAL PROPERTIES**

### **5.1 Pharmacodynamic properties**

Pharmacotherapeutic group: Psycholeptics, benzodiazepine derivatives ATC code: N05CD08.

#### Mechanism of action

Midazolam is a derivative of the imidazobenzodiazepine group. The free base is a lipophilic substance with low solubility in water. The basic nitrogen in position 2 of the imidazobenzodiazepine ring system enables midazolam to form the hydrochloride salt with acids. These produce a stable solution suitable for oromucosal administration.

#### Pharmacodynamic effects

The pharmacological action of midazolam is characterized by short duration because of rapid metabolic transformation. Midazolam has an anticonvulsant effect. It also exerts a sedative and sleep-inducing effect of pronounced intensity, and an anxiolytic and a muscle-relaxant effect.

#### Clinical efficacy and safety

In 4 rectal diazepam controlled studies and one study versus intravenous diazepam, in a total of 688 children, cessation of visible signs of seizures within 10 minutes was observed in 65% to 78% of children receiving oromucosal midazolam. Additionally, in 2 of the studies, cessation of visible signs of seizures within 10 minutes without recurrence within 1 hour after administration was observed in 56% to 70% of children. The frequency and severity of adverse drug reactions reported for Oromucosal midazolam during published clinical trials were similar to the adverse drug reactions reported in the comparative group using rectal diazepam. These efficacy and safety results have been confirmed for adults with seizures in both controlled and descriptive studies. Additionally, many published European national guidelines recommended the use of oromucosal midazolam for the management of acute seizures in adults.

The European Medicines Agency has waived the obligation to submit the results of studies with Midazolam in the subset of the paediatric population < 3 months old, on the grounds that the specific medicinal product does not represent a significant therapeutic benefit over existing treatments for these paediatric patients.

## 5.2 Pharmacokinetic properties

Simulated pharmacokinetic parameters for the recommended posology in children aged 3 months to less than 18 years, based on a population pharmacokinetic study are provided in tabulated format below:

Dose	Age	Parameter	Mean	SD
2.5 mg	3 m < 1 yr	AUC <sub>0-inf</sub> (ng.h/ml)	168	98
		C <sub>max</sub> (ng/ml)	104	46
5 mg	1 yr < 5 yrs	AUC <sub>0-inf</sub> (ng.h/ml)	242	116
		C <sub>max</sub> (ng/ml)	148	62
7.5 mg	5 yrs < 10 yrs	AUC <sub>0-inf</sub> (ng.h/ml)	254	136
		C <sub>max</sub> (ng/ml)	140	60
10 mg	10 yrs < 18 yrs	AUC <sub>0-inf</sub> (ng.h/ml)	189	96
		C <sub>max</sub> (ng/ml)	87	44
10 mg	> 18 yrs	AUC <sub>0-inf</sub> (ng.h/ml) (n=22)	259	62
		C <sub>max</sub> (ng/ml) (n=22)	71	29

Simulated pharmacokinetic parameters for the recommended posology in adults, based on a pharmacokinetic study, suggested that the dose of 10 mg in all adults lead to similar exposure to that of all pediatrics age groups at their corresponding therapeutic doses.

### Absorption

After oromucosal administration midazolam is absorbed rapidly. Maximum plasma concentration is reached within 30 minutes in children. The absolute bioavailability of oromucosal midazolam is about 75% in adults. The bioavailability of oromucosal midazolam has been estimated at 87% in children with severe malaria and convulsions.

### Distribution

Midazolam is highly lipophilic and distributes extensively. The steady state volume of distribution following oromucosal administration is estimated to be 5.3 l/kg.

Approximately 96-98% of midazolam is bound to plasma proteins. The major fraction of plasma protein binding is due to albumin. There is a slow and insignificant passage of midazolam into the cerebrospinal fluid. In humans, midazolam has been shown to cross the placenta slowly and to enter foetal circulation. Small quantities of midazolam are found in human milk.

#### Biotransformation

Midazolam is almost entirely eliminated by biotransformation. The fraction of the dose extracted by the liver has been estimated to be 30-60%. Midazolam is hydroxylated by the cytochrome P4503A4 isozyme and the major urinary and plasma metabolite is alpha-hydroxy-midazolam. Following oromucosal administration the area under the curve ratio for alpha-hydroxy midazolam to midazolam is 0.46 in children and 0.28 in adults.

In a population pharmacokinetic study, the metabolite levels are shown to be higher in younger than older paediatric patients and thus likely to be of more importance in children than in adults.

#### Elimination

Plasma clearance of midazolam in children following oromucosal administration is 30 ml/kg/min. The initial and terminal elimination half-lives are 27 and 204 minutes, respectively. Midazolam is excreted mainly by the renal route (60-80% of the injected dose) and recovered as glucuroconjugated alpha-hydroxy-midazolam. Less than 1% of the dose is recovered in urine as unchanged medicinal product.

#### Pharmacokinetics in special populations

##### *Elderly*

In adults over 60 years of age, the elimination half-life may be prolonged up to four times.

##### *Obese*

The mean half-life is greater in obese than in non-obese patients (5.9 versus 2.3 hours). This is due to an increase of approximately 50% in the volume of distribution corrected for total body weight. The clearance is not significantly different in obese and non-obese patients.

##### *Hepatic impairment*

The elimination half-life in cirrhotic patients may be longer and the clearance lower as compared to those in healthy volunteers (see section 4.4).

##### *Renal impairment*

The elimination half-life in patients with chronic renal failure is similar to that in healthy volunteers.

The elimination half-life of midazolam is prolonged up to six times in the critically ill.

##### *Cardiac insufficiency*

The elimination half-life is longer in patients with congestive heart failure compared with that in healthy subjects (see section 4.4).

##### *Exposure following a second dose in the same seizure episode*

Simulated exposure data show that the overall AUC approximately doubles when a second dose is administered at 10, 30 and 60 minutes following the first dose. A second dose at 10 minutes results in a significant increase in mean  $C_{max}$  of between 1.7 to 1.9-fold. At 30 and 60 minutes, significant elimination of midazolam has already occurred and therefore the increase in

mean  $C_{\max}$  is less pronounced; 1.3 to 1.6 and 1.2 to 1.5-fold respectively (see section 4.2).

*Race*

Clinical studies have included patients from Japanese and non-Japanese groups, and no differences in the pharmacokinetic profile have been identified on exposure to Midazolam.

No dose adjustment is warranted.

### **5.3 Preclinical safety data**

In a rat fertility study, animals dosed up to ten times the clinical dose, no adverse effects on fertility were observed.

There are no other preclinical data of relevance to the prescriber which are additional to that already included in other sections of the SmPC.

## **6 PHARMACEUTICAL PARTICULARS**

### **6.1 List of excipients**

Sodium chloride

Water for injections

Hydrochloric acid (for pH adjustment and conversion of midazolam to the hydrochloride salt)

Sodium hydroxide (for pH adjustment)

### **6.2 Incompatibilities**

Not applicable

### **6.3 Shelf life**

Midazolam 10 mg oromucosal solution

2 years

#### 6.4 Special precautions for storage

Keep the oral syringe in the protective plastic tube.

Do not refrigerate or freeze.

#### 6.5 Nature and contents of container

Amber, pre-filled needle-free oral syringe (polypropylene) with plunger (polypropylene) and end cap (high density polyethylene) packed in a protective, capped plastic tube.

Strength	Volume of solution	Syringe volume	Age range	Label colour
2.5 mg	0.5 ml	1 ml	3 months to < 1 year	Yellow
5 mg	1 ml	3 ml	1 year to < 5 years	Blue
7.5 mg	1.5 ml	3 ml	5 years to < 10 years	Purple
10 mg	2 ml	3 ml	10 years to < 18 years	Orange

Midazolam is available in two pack sizes:

- cartons containing 2 pre-filled syringes
- cartons containing 4 pre-filled syringes

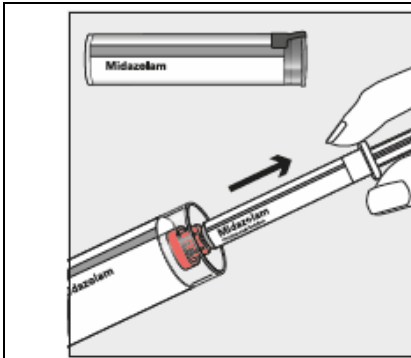
Not all pack sizes may be marketed.

#### 6.6 Special precautions for disposal

##### Administration of Midazolam

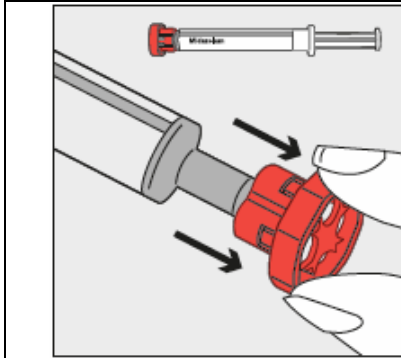
Midazolam is not for intravenous use.

##### **Step 1**



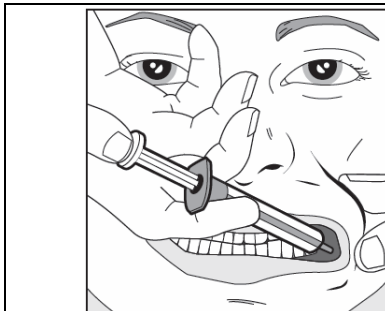
Hold the plastic tube and pull the cap off.  
Take the syringe out of the tube.

**Step 2**



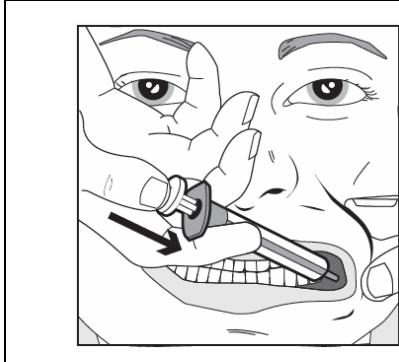
Pull the red cap off the tip of the syringe  
and dispose of it safely.

**Step 3**



Using the finger and thumb gently pinch  
and pull back the patient's cheek. Put the  
tip of the syringe into the back of the space  
between the inside of the cheek and the  
lower gum.

**Step 4**



Slowly press the syringe plunger until the  
plunger stops.  
The full amount of solution should be  
inserted slowly into the space between the  
gum and the cheek (buccal cavity).  
If necessary (for larger volumes and/or  
smaller patients), approximately half the  
dose should be given slowly into one side  
of the mouth, then the other half given  
slowly into the other side.

Any unused medicinal product or waste material should be disposed of in accordance with local requirements.

**7      MARKETING AUTHORISATION HOLDER**

Neuraxpharm Pharmaceuticals, S.L.  
Avda. Barcelona 69  
08970 Sant Joan Despí - Barcelona  
Spain

**8      MARKETING AUTHORISATION NUMBER(S)**

PLGB 16869/0028

**9      DATE OF FIRST AUTHORISATION/RENEWAL OF THE  
AUTHORISATION**

18/06/2025

**10     DATE OF REVISION OF THE TEXT**

18/06/2025