

# MIDAZOLAM INFUSION FOR THE ACUTE MANAGEMENT OF SEIZURES IN COMMERCIAL TRAVELLERS WARD - CHW

## PRACTICE GUIDELINE<sup>®</sup>

### DOCUMENT SUMMARY/KEY POINTS

**Note:** This practice guideline applies exclusively to Commercial Travellers (CT) Ward of the Children's Hospital at Westmead (CHW). A continuous intravenous (IV) midazolam infusion may be required for the treatment of intractable seizures in the event of status epilepticus when other drug therapy has failed.

- A continuous IV midazolam infusion may be commenced when seizures persist despite the patient receiving appropriate treatment (such as a loading dose of an anti-epileptic drug, or bolus dose(s) of midazolam).
- The midazolam infusion is prescribed by the Neurology registrar/resident *in direct consultation with the Neurology fellow or consultant* within business hours. After-hours, the Medical/sub-specialty registrar or a member of the Paediatric Intensive Care Outreach Service (PICOS) can order the infusion, after consultation with the Neurology fellow or consultant.
- Children who have not previously had an IV midazolam infusion require admission into the Paediatric Intensive Care Unit (PICU).
- Concentrations of IV midazolam infusion greater than 0.5 milligrams/mL are an irritant to the vein when administered peripherally. Some patients may need a Central Venous Access Device (CVAD) if this concentration is exceeded.
- An IV midazolam order must be reviewed every 24 hours, and the midazolam syringe changed every 24 hours.
- Any patient who becomes clinically unstable or who has worsening seizures must be urgently reviewed by the on-call Neurology team and PICOS. The Rapid Response team or Arrest team must be alerted as per [Between The Flags – Clinical Emergency Response System – SCHN](#). Assisted ventilation may be required.

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

<b>Approved by:</b>	SCHN Policy, Procedure and Guideline Committee	
<b>Date Effective:</b>	1 <sup>st</sup> December 2019	<b>Review Period:</b> 3 years
<b>Team Leader:</b>	Clinical Nurse Educator	<b>Area/Dept:</b> Commercial Traveller's Ward CHW

## CHANGE SUMMARY

- This practice guideline now incorporates electronic medical record (eMR) documentation of an IV midazolam infusion on Powerchart.
- There are links within this document to eMR Quick Reference Guides (QRGs) on how to prescribe an IV midazolam infusion in the Medication Administration Record (MAR), and how to document the midazolam infusion checks in Interactive View and I&O (IView).
- Original appendices have been removed as above QRGs are now available via the Sydney Children's Hospital Network (SCHN) intranet.
- For patients >83 kilograms, the midazolam syringe is prepared to a drug dose and dilution of 250milligrams midazolam in 50mL 0.9% NaCl (or 5% glucose). Note that 1mL will NOT equal 1microgram/kilogram/minute. The rate will need to be individualised according to the dose required.
- Figures added to clarify that on CT Ward, the midazolam infusion syringe line is connected via y-site with an IV fluid line of 0.9% NaCl (or 5% glucose if clinically indicated) running at "to keep the vein open" (TKVO) rate. This is good practice particularly for CVADs, to prevent blockage (see [Central Venous Access Devices \(CVAD\) Practice Guideline](#)).
- Instructions added regarding midazolam infusion rate changes verbally prescribed by the Neurology fellow/consultant, in line with the [Medication Handling in NSW Public Health Facilities NSW Health Policy Directive](#).
- The midazolam infusion accreditation process for registered nurses on CT ward is mentioned.

## WHO SHOULD READ THIS

- Medical staff prescribing an IV midazolam infusion for patients
- Accredited registered nurses administering and caring for patients receiving an IV midazolam infusion on CT Ward
- Clinical staff from PICU/PICOS who may be contacted to assist with a patient receiving an IV midazolam infusion
- Patient Flow team members

This document reflects what is currently regarded as safe practice. However, as in any clinical situation, there may be factors which cannot be covered by a single set of guidelines. This document does not replace the need for the application of clinical judgement to each individual presentation.

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## Rationale

- Commercial Travellers (CT) Ward is the only unit in Australia that administers continuous intravenous (IV) midazolam infusions outside of the Paediatric Intensive Care Unit (PICU) setting. CT ward has safely managed IV midazolam infusions for over ten years utilising the evidence-based practice recommendations outlined in this document.
- This practice guideline aims:
  - To facilitate the safe commencement and management of a continuous IV midazolam infusion on CT ward, for the treatment of intractable seizures.
  - To assist in determining the appropriate clinical area for the commencement and management of a continuous IV midazolam infusion.
  - To describe the medical and nursing considerations regarding the commencement and management of a continuous IV midazolam infusion.
  - To facilitate the safe and effective management of a patient receiving a continuous IV midazolam infusion who deteriorates in terms of airway, breathing, circulation, and/or seizure activity.

## Definition

Midazolam is a short-acting benzodiazepine that acts on the nervous system as a sedative, hypnotic, anxiolytic and amnesic agent<sup>1</sup>. Midazolam can be used for the acute management of seizures<sup>2</sup>.

Midazolam has been shown to be safe and highly effective when administered as a continuous IV infusion for the acute management of status epilepticus in adults, children and infants<sup>3-6</sup>. Strict clinical criteria need to be met in order for nursing staff to safely manage a patient receiving a continuous IV midazolam infusion on CT ward (see "[Nursing Principles](#)").

## Midazolam Infusion

- A continuous midazolam infusion is administered intravenously via a peripheral cannula or Central Venous Access Device (CVAD). A midazolam infusion concentration greater than 0.5 milligrams/mL is an irritant to the vein when administered via a peripheral cannula<sup>7</sup>. Some patients may thus need a CVAD if this concentration is exceeded.
- The midazolam infusion is administered using a syringe pump, and the syringe is changed every 24 hours<sup>2</sup>. A volume-limit pump is required.
- To further maintain patency, the midazolam infusion syringe line is connected via y-site with a maintenance fluid line of 0.9% NaCl (or 5% glucose if clinically indicated), running at "to keep the vein open" (TKVO) rate. This is good practice particularly for CVADs (see [Central Venous Access Devices \(CVAD\) Practice Guideline](#)).

## Which clinical area?

### Commencement of Midazolam Infusion in CT Ward - Flowchart

Decision made by Neurology Consultant/Fellow to commence Midazolam infusion.

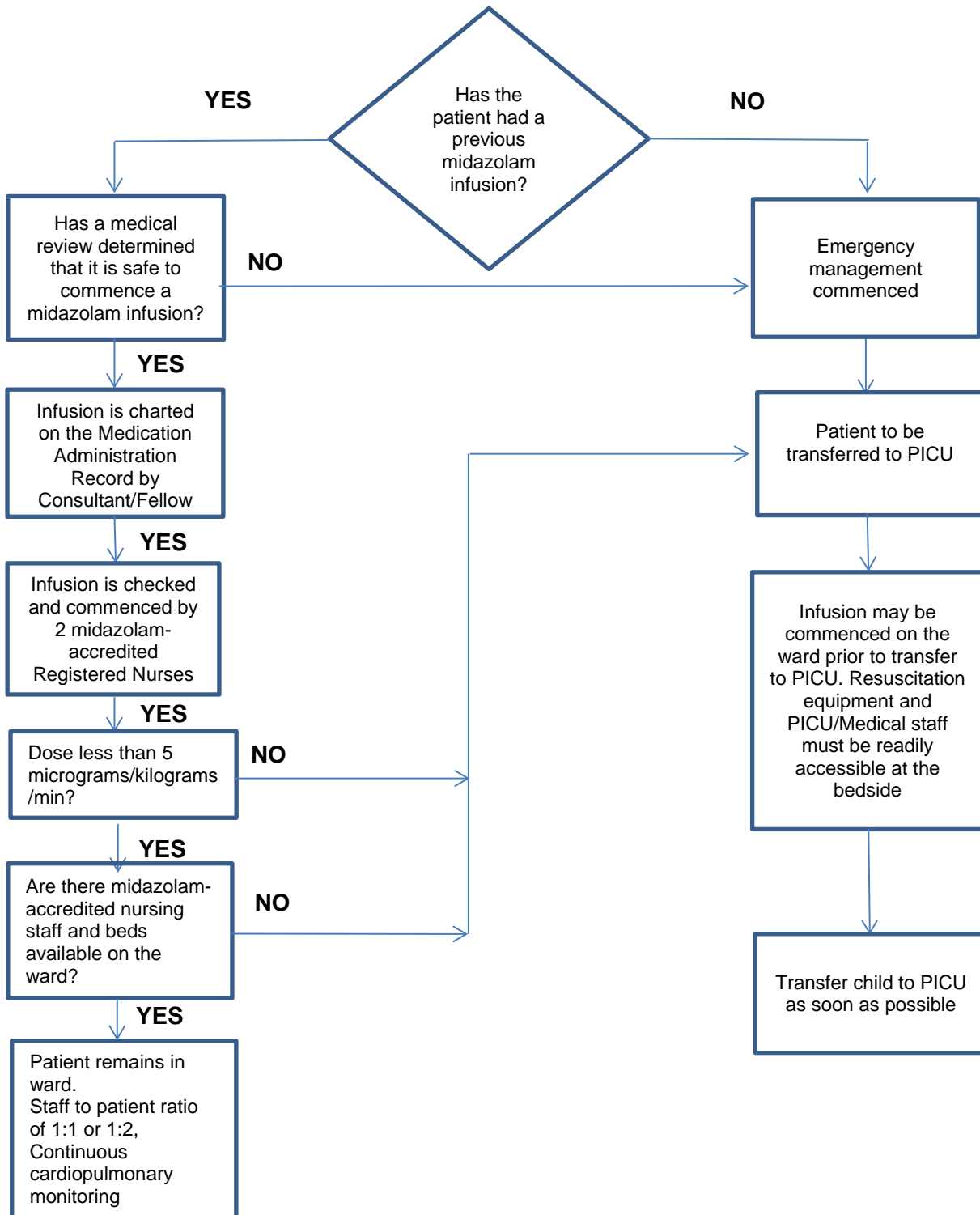


Figure 1. Flowchart for commencement of midazolam infusion on CT ward.

## Transfer from Ward to PICU

- See [Figure 1](#) – Flowchart for commencement of midazolam infusion on CT Ward.
- If a patient on the ward requires a high dose midazolam infusion (>5micrograms/kilogram/minute), admission to PICU is required to ensure closer monitoring<sup>8</sup>.
- If a patient receiving a midazolam infusion suffers a significant respiratory compromise, significantly reduced level of consciousness, or cardiovascular collapse, a Rapid Response call at least must be made (2222) and assisted ventilation may be required (see [Between The Flags – Clinical Emergency Response System – SCHN Procedure](#)).
- A Medical officer or member of the PICOS must stay with the patient until transfer to PICU.
- Within business hours, the Neurology consultant or fellow liaises with nursing staff and PICU to facilitate the patient transfer.
- After hours, the Medical/sub-specialty registrar will contact the Neurology consultant or fellow and liaise with nursing staff and the PICOS to facilitate the transfer.

## Transfer from PICU to Ward

- A patient with a continuous midazolam infusion can be transferred to the ward from PICU when the following criteria are met:
  - The patient has been assessed and cleared for transfer by the PICU consultant in collaboration with the Neurology consultant or fellow.
  - The patient has demonstrated the ability to protect their airway and maintain adequate spontaneous ventilation for a period of **12 hours** whilst receiving the midazolam infusion in PICU<sup>9</sup>.
  - Adequate seizure control is demonstrated, as determined by the Neurology consultant or fellow<sup>9</sup>.
  - The patient is stable and ongoing medical review can be managed at the ward level.
  - The midazolam infusion rate is  $\leq 5$  micrograms/kilogram/minute<sup>7</sup>.
  - The ward NUM and nursing team leader are aware.
  - A nurse-to-patient ratio of 1:1 or 1:2 is confirmed in the ward area and continuous cardiorespiratory and oxygen saturation monitoring is available, due to the risk of cardiorespiratory depression and respiratory arrest<sup>7,9</sup>, and taking into account the patient's condition/seizure status.

## Drug Information

The information below is a summary. Refer to [MIMS](#) and [CHW Paediatric Injectable Medicines Handbook](#) for more complete information on midazolam.

- **Availability** – there are several strengths of midazolam injection available, including 5 milligram/mL, 15 milligram/3 mL and 50 milligram/10mL ampoules.
- **Preparation** – an IV midazolam infusion may be prepared in 0.9% sodium chloride (NaCl) or 5% glucose. See [MIMS](#) or [CHW Paediatric Injectable Medicines Handbook](#) for further preparation instructions.
- **Compatibility** – a midazolam infusion syringe must NOT be mixed or diluted with other medications.
- **Dosage** – consistent with the [CHW Meds4Kids Dosing Guide](#), a loading dose of 100–200micrograms/kilogram midazolam may be given prior to the continuous IV midazolam infusion commencing. This, and the dose of continuous midazolam to be administered by IV infusion, is determined by the Neurology consultant or fellow. As a general guide, the starting dose is 1-2micrograms/kilogram/minute and the range is 1-5 micrograms/kilogram/minute<sup>7,10</sup>.
- **Adverse reactions** – some common adverse reactions are listed below. Refer to the [MIMS](#) for a more comprehensive list.

Cardiovascular: Cardiac arrest, hypotension and bradycardia.

Central Nervous System: Drowsiness, sedation, amnesia, dizziness, headache, ataxia, nystagmus, and hyperactivity.

Monitor especially for **respiratory depression** (bradypnoea), apnoea, respiratory arrest and oxygen desaturation.

## Prescribing a midazolam infusion

- Refer to the [“Midazolam Infusion Prescribing” Quick Reference Guide](#) under the Sydney Children’s Hospital Network (SCHN) “Learning.kids” webpage on the SCHN intranet.
- A midazolam infusion is prescribed by the Neurology registrar/resident in direct consultation with the Neurology fellow or consultant within business hours.
- After hours, the Medical/sub-specialty registrar or a member of the PICOS can order the infusion, after consultation with the Neurology fellow or consultant.
- Midazolam infusions are prescribed on the Medication Administration Record (MAR) on Powerchart.
- The midazolam infusion order must be reviewed every 24 hours.<sup>1</sup>



- **For IV infusion, midazolam must be diluted as follows;**  
**3 milligram/kilogram in 50mL of 0.9% NaCl, or 5% glucose if clinically indicated<sup>7</sup>.**  
**1mL/hour of this solution is equivalent to delivering**  
**1microgram/kilogram/minute<sup>7</sup>.**

Example of calculation of midazolam infusion for a 20 kilogram child:

20kg x 3milligrams = 60milligrams midazolam

Drug dose and dilution: Midazolam 60milligrams in 50mL 0.9% sodium chloride.

*Note:* this produces a concentration of 1.2mg/mL midazolam and should be administered via a CVAD

- Note that this method of dilution is unsuitable for patients >83 kilograms.
- For patients >83 kilograms, prepare the syringe to a drug dose and dilution of 250milligrams midazolam in 50mL 0.9% NaCl (or 5% glucose). Note that 1mL will NOT equal 1microgram/kilogram/minute. The rate will need to be individualised according to the dose required.
- A midazolam infusion concentration >0.5milligrams/mL is an irritant to the vein when administered via peripheral cannula<sup>7</sup>. Consider whether the patient will need a CVAD if this concentration is exceeded.

## Modifying dose/rate

- If a patient receiving a midazolam infusion continues to have seizures, the Neurology consultant/fellow may decide to increase the midazolam infusion rate.
- Neurology consultant/fellow approval must be obtained prior to increasing or decreasing the midazolam infusion rate, and the midazolam infusion MAR order must be updated with the new rate.
- The Neurology team must also document infusion rate changes in the patient progress notes AND communicate this to the nursing team leader.
- If there is a delay in Neurology documentation of the new rate, nurses may change the rate with only a verbal order, but this must be followed up with documentation from the Neurology team within the same shift.
- If a rate change is verbally ordered by the Neurology fellow/consultant to be effective immediately, two midazolam infusion accredited registered nurses must hear this verbal order and document this change on the IV Drips section, including witness signature (see ["Midazolam Infusion Administration" Quick Reference Guide](#)). This is consistent with the [Medication Handling in NSW Public Health Facilities NSW Health Policy Directive](#).
- Weaning the midazolam infusion is dependent on the patient's clinical condition and is directed by the Neurology consultant or fellow.



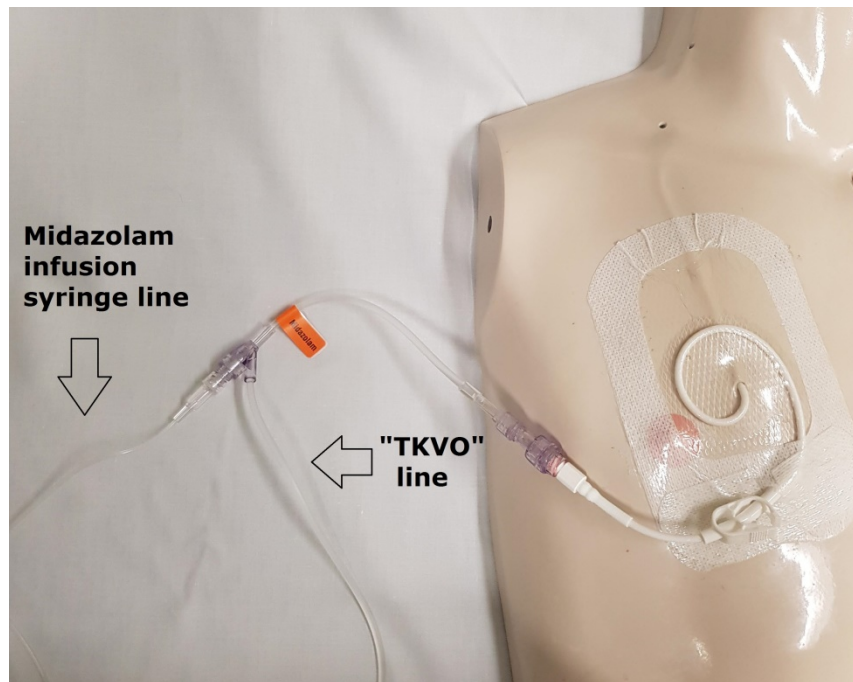
## Bolus Doses

- A patient receiving a continuous IV midazolam infusion may also require an IV midazolam bolus.
- An IV midazolam bolus is prescribed by the Neurology registrar/resident in direct consultation with the Neurology consultant or fellow, taking into consideration the current rate of the continuous midazolam infusion. After hours, the Medical/sub-specialty registrar or member of the PICOS can prescribe a bolus after consultation with the Neurology consultant or fellow.
- Each bolus dose must be prescribed on the MAR as a "STAT" dose. The [MIMS](#) and the [CHW Paediatric Injectable Medicines Handbook](#) provide guidelines for prescribing bolus doses.
- The midazolam bolus must be administered by Senior Medical staff only (registrar or above).
- Midazolam boluses are administered **separate to** the continuous midazolam infusion syringe.
- Nursing staff must obtain a full set of vital signs before and after a midazolam bolus.
- Administration of bolus doses must also be documented in the patient's electronic progress notes.

## Nursing Principles for Management in the Ward

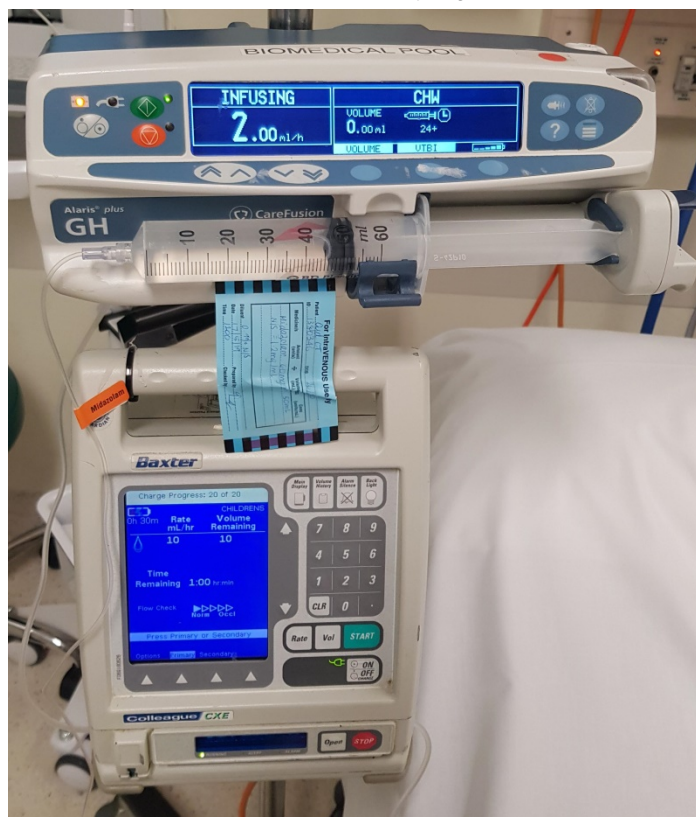
### Administration

- Nursing staff on CT ward must be accredited to administer a continuous IV midazolam infusion and care for patients receiving the infusion.
- Only registered nurses on CT ward (RN2 and above) can be accredited by the CT ward clinical nurse educators (CNEs). Accreditation involves theoretical and practical components, including the CT ward midazolam infusion accreditation package, which is obtained from CT ward CNEs to be used in conjunction with this practice guideline.
- The midazolam infusion must be administered via a dedicated line.
- The midazolam infusion is administered using a syringe pump, and the syringe is changed every 24 hours<sup>2</sup>. A volume-limit pump is required.
- The midazolam infusion syringe line is then connected via y-site with an IV fluid line of 0.9% NaCl (or 5% glucose if clinically indicated) running at "to keep the vein open" (TKVO) rate (see [Figure 1](#) and [Figure 2](#)). This TKVO line remains dedicated for the midazolam infusion only, and is good practice particularly for CVADs, to prevent blockage (see [Central Venous Access Devices \(CVAD\) Practice Guideline](#)).
- In an emergency, a high dose continuous midazolam infusion >5micrograms/kilogram/minute can be commenced on the ward **with the Medical registrar present**, but the patient receiving the infusion must be admitted into PICU immediately after (see [Transfer from Ward to PICU](#) section).



**Figure 1.** Midazolam infusion connected to TKVO line via y-site on CT Ward.

**Figure 2.** Infusion pumps required for midazolam syringe line and TKVO line.



- Patients receiving a midazolam infusion on the ward must be cared for at a nurse-to-patient ratio of 1:1 or 1:2, arranged in consultation with the Neurology team and Nursing Unit Manager, due to the risk of cardiorespiratory depression and respiratory arrest<sup>9</sup> and

taking into account the patient's condition/seizure status (see [Transfer from PICU to Ward](#) section).

- A midazolam infusion order must be reviewed every 24 hours. If a midazolam syringe runs out **within** the 24 hours and the order has not yet been reviewed, nurses can continue to use the existing order to prepare a new midazolam syringe, but must liaise with the Neurology team as soon as possible afterwards to ensure the order is reviewed and remains correct.
- When commencing a new midazolam syringe, nurses must reset the values on the volume limit pump and note this in the hourly infusion checks on IView, to assist in clearer documentation (refer to [Documentation](#) section).
- An IV medication label must be fully completed and attached to the midazolam syringe.

## Documentation

- Refer to the [“Midazolam Infusion Administration” Quick Reference Guide](#) for nurses under the SCHN “Learning.kids” webpage on the SCHN intranet.
- Nurses must document continuous IV midazolam infusion checks in 3 sections on Powerchart: 1) Titratable infusions, 2) IV Drips, and 3) the Fluid Balance.
- If a rate change is verbally ordered by the Neurology fellow/consultant to be effective immediately, two midazolam infusion accredited registered nurses must hear this verbal order and document this change on the IV Drips section, including witness signature (see [“Midazolam Infusion Administration” Quick Reference Guide](#), page 2). This is consistent with the [Medication Handling in NSW Public Health Facilities NSW Health Policy Directive](#).
- The following instructions elaborate on calculations for the Titratable infusions section:
  - When filling in “Amount left in syringe”, subtract the volume of midazolam infused since the previous hour, depending on the rate. For example, if the rate is 2mL/hour, and the syringe had 49mL in total the previous hour, then the next hour there should be 47mL left in the syringe.
  - To work out the “Progressive total amount of drug infused” every hour, you must calculate how many milligrams per hour of midazolam is meant to infuse.
    - i. First, divide the prescribed dose of midazolam by the volume it is diluted. For example, if the order is 60milligrams midazolam in 50mL of 0.9% NaCl:

$$60\text{mg} \div 50\text{mL} = 1.2\text{mg per mL.}$$
    - ii. Next, look at the prescribed rate and multiply by this number to figure out how many milligrams per hour. For example, for a rate of 2mL/hour:

$$1.2\text{mg/mL} \times 2\text{mL/hour} = 2.4\text{mg per hour.}$$
    - iii. If there are no issues with the infusion when you do your hourly check, continue to add the milligrams per hour you have just calculated to the “Progressive total amount of drug infused”.

## Observations

- **Continuous pulse oximetry** with alarms set to appropriate parameters as per Between the Flags protocol (see [Between The Flags – Clinical Emergency Response System - SCHN Procedure](#)), and documentation of **pulse and respiratory rate hourly** on the patient's Between the Flags (BTF) observation chart in Powerchart.
- **Hourly observations** of the child's level of consciousness using the Alert, Voice, Pain and Unresponsive scale also within the patient's BTF observation chart, monitoring particularly for signs of over-sedation<sup>2</sup>.
- **Temperature and blood pressure every four hours.**
- **Hourly infusion checks** including visualising the patient's IV insertion site and documenting infusion details (see [Documentation](#) section).
- **For bolus doses of midazolam**, a full set of vital sign observations should be obtained before and after each bolus.

**Safety precautions** must also be taken, such as bolsters on bed rails, to protect the patient from potential injury from seizures as per the [Seizures – Acute Management in Infants and Children Practice Guideline](#)

## Management of clinical deterioration

- Regarding clinical deterioration in general, the [Between The Flags – Clinical Emergency Response System - SCHN Procedure](#) applies.
- In case of significant respiratory depression:
  - **Stop the infusion immediately** and call 2222 to activate a Rapid Response at least (see [Between The Flags – Clinical Emergency Response System - SCHN Procedure](#)). Assisted ventilation may be required.
  - Initiate cardiopulmonary resuscitation as necessary (see [Cardiopulmonary Resuscitation and Equipment Practice Guideline](#)).
  - The patient must have an urgent review by Neurology and PICU within business hours or an urgent review by the Medical/sub-specialty registrar and PICOS after-hours.
  - If the patient continues to have seizures, check if other anti-epileptic drugs can be given whilst the midazolam infusion has been ceased (see [Seizures – Acute Management in Infants and Children Practice Guideline](#)).
- Patients on a continuous IV midazolam infusion should be flagged by the Neurology team to relevant after-hours Medical staff, to increase awareness and vigilance in case of deterioration.

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