



INTRODUCTION

Fluid infusion pumps and syringe pumps are used to deliver accurate flow rates, including for fluid therapy, analgesics, and vasoactive drugs. These devices support patient safety by ensuring accurate medication delivery. However, patient weight, drug concentration, dose, and units must be entered correctly. Additionally, the volume per hour should always be checked before starting the infusion.

This safety bulletin presents two fictionalized scenarios based on events reported to SAFER in which incorrect syringe pump programming resulted in overdoses. Species, drugs, and event details have been modified to protect reporter and patient anonymity.

Keywords: infusion device, syringe pump, constant rate infusion, CRI



CASE 1

A dog undergoing general anesthesia for an elective procedure was given a fentanyl constant rate infusion (CRI) for analgesia. An infusion of 10 $\mu\text{g kg}^{-1} \text{ hour}^{-1}$ was planned; however, the dose given for several minutes was 10 $\text{mg kg}^{-1} \text{ hour}^{-1}$. Following the overdose, the dog developed marked bradycardia with second-degree atrioventricular block and hypotension. The supervising anesthetist recognized the error and stopped the infusion. Bradycardia and hypotension resolved after giving intravenous atropine (0.04 mg kg^{-1}).

Contributing factors included unfamiliarity with the infusion pump model. According to the individual submitting the error report (reporter), the drug concentration unit automatically changed based on the dose unit entered. The concentration was initially programmed in mg mL^{-1} , followed by entry of the dose in $\mu\text{g kg}^{-1} \text{ minute}^{-1}$. The pump automatically converted the concentration unit from mg mL^{-1} to $\mu\text{g mL}^{-1}$ without adjusting the numerical value, resulting in a displayed concentration that was 1000-fold lower than intended and an infusion rate that was 1000-fold higher than intended.

Contribution(s) to error: The reporter identified a poorly designed user interface and pump configuration process, combined with inadequate verification before initiating the infusion.

Consultation with the pump manufacturer: The SAFER team contacted the manufacturer, who provided additional details about the pump described in the report. According to the manufacturer, and based on videos demonstrating the operation of the referenced pump, the units displayed may change between programming steps after the initial unit has been selected.

For example, if step 1 involves setting the drug solution concentration and the concentration is entered in mg mL^{-1} , the dose units to be programmed in step 2 may change automatically without user input.

The manufacturer emphasized the importance of carefully reviewing all information displayed on the pump screen before initiating the infusion. This recommendation is consistent with the pump instruction manual.



CASE 2

A lidocaine CRI of 50 $\mu\text{g kg}^{-1} \text{ minute}^{-1}$ was planned for a rabbit, using a syringe pump. However, the pump was incorrectly programmed to deliver 50 **mg** $\text{kg}^{-1} \text{ minute}^{-1}$.

The unit error was identified after a cumulative dose of approximately 5 mg kg^{-1} had been given. The infusion was immediately discontinued, and the planned regional anesthesia technique was cancelled to minimize the risk of local anesthetic toxicity.

Contributing factors included operator unfamiliarity with the syringe pump and overnight staffing conditions (i.e., team fatigue and understaffing).

Why the error occurred: The reporter described a programming error involving incorrect dose units (mg instead of μg), likely facilitated by fatigue.



SIMILAR CASE

A case report described a rocuronium overdose caused by an incorrect time unit setting, in the context of inappropriate time pressure from another team member (Nursio & Bernal 2026). Rocuronium was intended to be infused at 0.2 $\text{mg kg}^{-1} \text{ hour}^{-1}$. Although the calculation was performed correctly as $\text{mg kg}^{-1} \text{ hour}^{-1}$, the infusion pump was programmed to deliver 0.2 $\text{mg kg}^{-1} \text{ minute}^{-1}$. As a result, the infusion rate was 60-fold higher than intended (Nursio & Bernal 2026).



OTHER POSSIBLE ERRORS INVOLVING INFUSION DEVICES

Wrong dilution: A calculation error during drug preparation may result in an incorrect drug concentration. In this situation, even if the infusion pump is programmed correctly, the incorrect concentration may lead to delivery of the wrong dose.

Free flow: This type of error can occur when an infusion pump lacks an anti-free-flow mechanism, and intravenous tubing is not clamped before the infusion is loaded into or removed from the pump. It may occur during the replacement of infusion solutions and can result in an overdose.



MITIGATION STRATEGIES

- Double-checks
 - Dose, drug concentration and units should always be carefully checked during setup.
 - Cognitive aids, such as electronic spreadsheets for individual calculations or reference sheets with expected dose ranges for different weight categories in commonly treated species, help verify medication doses.
 - Double-checking drug preparation should be performed routinely throughout the day and given additional attention during overnight shifts and periods associated with fatigue or reduced staffing.
- Having standardized guidelines for infusion pump programming (e.g. standardized dilution and unit set up) can help reduce errors.

When syringe pumps go wrong: risks linked to incorrect constant rate infusion programming

SAFETY BULLETIN 01. | SEPTEMBER 2026

- Users should be given adequate training and demonstrate familiarity with infusion pump operation and possible errors before clinical use.



HOW TO FACILITATE ERROR IDENTIFICATION

- Close patient monitoring facilitates early recognition of wrong doses (e.g. electrocardiographic changes)
- Familiarity with commonly used drug doses and volumes

* Early recognition of an error when it occurs can help reduce harm to patients. However, these strategies are limited because they rely entirely on human vigilance and training and are therefore considered weak. They should be combined with stronger strategies (see page 2).



CONCLUSION

Infusion devices are valuable tools for improving the accuracy and safety of constant rate infusions; however, programming errors can result in patient harm. Preventing infusion-related errors requires a combination of safe device design, standardized CRI preparation and programming procedures, staff training, and systematic verification of drug concentrations, dose units, infusion rates, and programmed volumes before administration. Although many infusion pumps perform automatic calculations, these do not eliminate the need for independent double-checking.



KEY HIGHLIGHTS

- Errors in infusion pump programming can lead to wrong dose errors
- Data entered into infusion devices should be checked before starting an infusion
- Incorrect units (dose, concentration, or time) are a critical contributing factor to CRI programming errors (e.g., mg mL^{-1} versus $\mu\text{g mL}^{-1}$; $\text{mg kg}^{-1} \text{ hour}^{-1}$ versus $\text{mg kg}^{-1} \text{ minute}^{-1}$)
- The final infusion volume calculated by the pump should always be reviewed and does not eliminate the need for independent double-checking



REFERENCE

Nussio, V. S., & Diez Bernal, S. (2026). Sugammadex reversal of an accidental rocuronium overdose in a dog in the context of incivility in the workplace. *Veterinary Anaesthesia and Analgesia*, 53(4), 101229. <https://doi.org/10.1016/j.vaa.2026.101229>

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