



# Intravenous Administration of Medicines to adults: Guidance on “line flushing” -Version 3 2021

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## 1. Introduction:

This document has been prepared, reviewed and updated by the board of the National Infusion and Vascular Access Society (NIVAS) of the United Kingdom with the advice of specialist nurses and doctors who are experts in the field of IV therapy and vascular access and experts on the use of medical devices and administration of injectable medicines.

This document is intended to give healthcare professions an overview of the issue of residual medicine volumes in infusion sets and updated guidance on flushing infusion sets, evidence-based recommendations for best practice. Where a gap in evidence exists, expert consensus will be offered. This guidance provides the basis for local review of practice and procedures for flushing lines, in order to facilitate the assessment of risks of underdosing with small volume infusions, and development of local policies by healthcare organisations. This document supersedes the Intravenous Infusion Drug Administration: Flushing Guidance for Adults Version 1 (NIVAS 2019).

In clinical practice, flushing intravenous infusion sets in adult patients is rare with the exception of administration of chemotherapy in Oncology (Harding *et al.*, 2020). There is a lack of national guidance and no standardisation or evidence to support a particular technique of flushing (Thoele *et al.*, 2018, Lam *et al.*, 2013, Cooper *et al.*, 2018).

Since the previous flushing guidance was published, NIVAS has received feedback from clinical practitioners and medical device experts and has reviewed the available evidence, which suggests that the issue of medicine losses in IV infusion sets is under-recognised, (Cooper *et al.* 2018, Cousins 2018) a considerable amount of medicine may be lost due to infusion sets dead space, (Plagge *et al.*, 2010) and administration methods must be improved in order to minimise underdosing (Harding *et al.*, 2020).

There is also the potential risk of bolus effect or incompatibilities with the residual medicine in infusion set, if the same set is subsequently used to administer other infusions. In the first instance infusion sets should NOT be continuously used for the administration of different medicine solutions, a new infusion set should be used for each new medicine. Infusion sets can be used continuously for fluid infusions such as sodium chloride 0.9% in line with local policy. (Cohen *et al.*, 2012, Shanmugam *et al.*, 2020)

NIVAS recognises that this change in practice may take time. Local practice guidelines should be reviewed and your organisation may need to consider how this is achieved long term. This guidance is intended to facilitate this process. NIVAS recognises that some of the recent published literature may not be totally accurate in its claims of the amount of residual medicine remaining in the infusion set if not flushed but the principle that all the prescribed medicine should be administered remains valid.

## 2. Administration of Intravenous Therapy

There are different methods of administration of intravenous medicines and the significance and potential impact of flushing, or lack of flushing, varies depending on the dead space of the infusion devices used in each case.

### 2.1 Intravenous Injection from a syringe directly into the cannula:



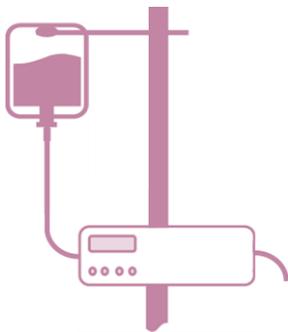
The administration of an IV injection from a syringe directly into peripheral venous access does not require the use of an infusion set. The cannula must be flushed before and after the administration of the IV medicine, generally with a small volume of up to 10mL of sodium chloride 0.9% or other compatible diluent, as per local policies.

### 2.2 Intravenous infusion via a syringe pump:



When an injection or infusion is administered from a syringe using a syringe pump, an intravenous extension tube is attached to connect the patient's venous access to the syringe. Syringe infusion sets hold a small volume of solution, generally around 2mL, depending on the type and length of the tube (it may vary, check specific sets in use in your organisation).

### 2.3 Intravenous infusion from a bag via a volumetric pump or gravity:



IV therapy can be delivered intravenously from an infusion bag to which a medicine has been added or as a ready-to-administer infusion.

The bag of fluid is connected to the vascular access device via an infusion set with a needle-free connector.

This method of administration may be chosen in preference to IV injection, (e.g. to administer certain antibiotics), as it makes possible to administer the IV therapy at a slower rate. This allows the rapid dilution of the medicine into the bloodstream and reduces the risk of chemical phlebitis.

When the infusion bag is empty the infusion set and tubing will still contain an amount of medicine.

### Significance of medicine losses in volumetric pump and gravity infusion sets

The dead space of volumetric pump and gravity infusion sets' is commonly in the range of 20-30mL, but this varies depending on the type and length of the tube. The volume that remains in an infusion set after administration may also vary depending on the type of set and the method of administration (gravity or via pump) (Harding *et al.*, 2020, Cooper *et al.*, 2018, Plagge *et al.*, 2010).

The final volume of the infusion to be administered needs also to be considered. The residual volume is more likely to be clinically significant for small infusions [100mL and, in particular, 50mL bags (Harding *et al.*, 2020).]

### 3. Flushing lines after infusing a medicine

#### Fixed rate infusions

These are infusions where the **total dose** to administer over a number of hours/minutes is prescribed. e.g. ceftriaxone 2g over 30 minutes.

#### Via syringe pump



At the end of the infusion, disconnect the syringe from infusion set and flush the line with sodium chloride 0.9% or a compatible diluent at the same rate of the infusion as the medicine previously administered.

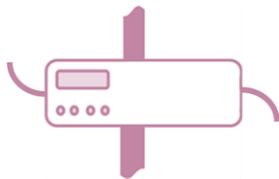
To achieve this it may be necessary to administer the flushing solution via syringe pump.

#### Via volumetric pump or gravity



At the end of the infusion, the medicine remaining in the infusion set should be flushed with sodium chloride 0.9% or other compatible diluent, using one of the methods described below (3.1. Methods for flushing infusions administered from a bag).

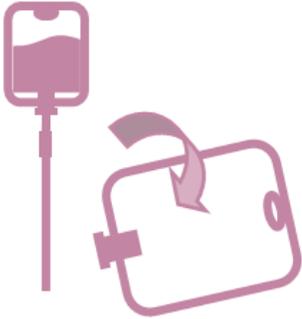
#### Variable rate continuous infusions via syringe or volumetric pump



For variable rate continuous infusions administered through a **Central Venous Access Device (CVAD)**, discard the infusion set and aspirate the cannula contents before flushing with sodium chloride 0.9%.

For variable rate continuous infusions (e.g. vasoactive, strong sedatives or anaesthetic medicines) administered through a **Peripheral Intravenous Venous Cannula (PIVC)**, discard the infusion set and flush the cannula at the same rate as the medicine infusion was administered in order to avoid a bolus effect.

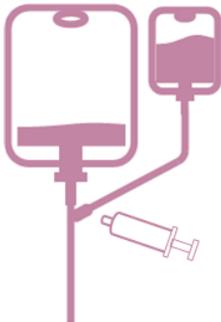
### 3.1. Methods for flushing infusions administered from a bag



#### Method 1

Use a 100mL or 50mL bag of sodium chloride 0.9% or other compatible infusion fluid to flush the infusion set. At least 20mL is generally required to ensure that all the medicine in the infusion set has been administered but the full bag may be administered if clinically acceptable. See safety warnings on fluid overload below.

1. Once the IV infusion has finished, engage the safety clamp of the infusion set.
2. Using an aseptic non-touch technique remove the infusion set spike from the used infusion bag.
3. Insert the infusion set spike into the entry point on the bag of compatible “flush” fluid
4. Infuse at the same rate as the previous medicine infusion.
5. Once the required flush volume has been infused, disconnect the infusion set from the vascular access device and dispose of it following local policy.



#### Method 2

IV infusion sets with an additional port are available. They allow the drip chamber to be filled with diluent from a syringe or bag of fluid; this allows the residual volume of medicines in the tubing to be administered at the same rate as the previous infusion. These infusion sets will need to be chosen to ensure they are compatible with the available infusion pumps.

1. Using a bag of flush fluid: Connect the bag to the secondary line, and once the medicine infusion bag is empty, open the clamp letting the drip chamber fill with a compatible flushing fluid. Infuse the flush solution at the same rate as the previous infusion.
2. Using a syringe: Infusion sets which have an injection port located above the drip chamber can be flushed by injecting the flush solution into the line once the medicine infusion bag is empty. Infuse the flush solution at the same rate as the previous infusion until the drip chamber is empty.

- Caution is important when infusing additional fluid as a flush because there is a risk of fluid overload in fluid restricted patients or patients receiving multiple daily infusions.
- The volume used for flushing should be minimised in fluid restricted patients.
- The volume of fluid administered when flushing IV lines must be accounted for in fluid balance records

## 4. Risk of inadvertent push administration

### 4.1 From residual volume of medicine in infusion sets

To avoid unintended push administration of medicine from the dead space in an infusion set, care should be taken to ensure the rate of administration of a flush or subsequent infusion is the same as the rate of administration of the medicine. An incident reported to the NRLS describes an infusion of potassium chloride in sodium chloride 0.9% that was changed for a bag of Hartmann's solution. Because the Hartmann's solution was infused faster than the potassium chloride infusion it replaced, the patient received an unintended push of the residual potassium solution.

### 4.2 From residual volume (especially of anaesthetic or sedative medicines) in vascular access devices

The [Patient Safety Alert NHS/PSA/D/2017/006- Confirming removal or flushing of lines and cannula after procedure](#), and recommendations from other international organisations (Grissinger, 2019), have highlighted the risk of unintended push administration from the residual anaesthetic or sedative medicines left in the lumens of vascular access devices after procedures. This is particularly relevant to peripheral cannula although the risk is present for all vascular access devices. Care should be taken to ensure all are flushed with a compatible fluid after administering a medicine

### 4.3 Other comments

- IV infusion sets used to administer large volume, medicine infusions of 250mL or more, or hydration fluids, do not need to be flushed as only a relatively small proportion of medicine will remain in the set.
- Pulsatile push pause flushing technique should be used to finally flush the vascular access device once the infusion set is disconnected.

## 5 Recommendations to healthcare organisations

This guidance should be read in conjunction with, and implementation should take into account

- Local Medicines Policy, including specialty-specific policies and associated education & training programmes
- The importance of awareness amongst staff administering IV medicines of the risks of
  - underdosing if infusion sets are not flushed
  - accidental push dosing if an inappropriate flushing technique is used
  - The range of medicine infusion devices available. This will ideally be managed via the establishment of a managed library of devices
- NICE guidance on intravenous fluid therapy in adults in hospital  
<https://www.nice.org.uk/guidance/cg174>

### References:

Brooks N, Remember the risks of intravenous therapy and know how to reduce the British Journal of Nursing, 2018, (IV Therapy Supplement) Vol 27, No 8

Cohen, Michael R. ScD, MS, RPH MEDICATION ERRORS, Nursing2012: October 2012 - Volume 42 - Issue 10 - p 9 doi: 10.1097/01.NURSE.0000419432.30180.83

Cooper DM, Rassam T, Mellor A. Non-flushing of IV administration sets: an under-recognised under-dosing risk. Br J Nurs. 2018 Jul 26; 27(14):S4-S12. doi: 10.12968/bjon.2018.27.14.S4. PMID: 30048183.

Cousins D. Patients are being underdosed: we need new guidance on small-volume drug infusions. *Clinical Pharmacist* 2018; 10(12):356–357. doi: 10.1211/CP.2018.20205779

Grissinger, M., 2019. Paralyzed by Mistakes—Reassess the Safety of Neuromuscular Blockers in Your Facility. *Pharmacy and Therapeutics*, 44(3), p.91.

Harding M, Stefka S, Bailey M, Morgan D, Anderson A. Best Practice for Delivering Small-Volume Intermittent Intravenous Infusions. *J Infus Nurs*. 2020 Jan/Feb;43(1):47-52. doi: 10.1097/NAN.0000000000000355.

Lam WJ, Bhowmick T, Gross A, Vanschooneveld TC, Weinstein MP. Using higher doses to compensate for tubing residuals in extended-infusion piperacillin-tazobactam. *Ann*

Pharmacother. 2013 Jun; 47(6):886-91. doi: 10.1345/aph.1R721. Epub 2013 May 28. PMID: 23715072.

National Infusion and Vascular Access Society. Intravenous infusion drug administration: flushing guidance. 2019. Available at: <https://nivas.org.uk/contentimages/main/NIVAS-Flushing-guidance-2019-final.pdf> (accessed May 2019)

NHS Improvement Patient Safety Alert NHS/PSA/D/2017/006: Confirming removal or flushing of lines and cannula after procedure. November 2017.

[https://improvement.nhs.uk/documents/1922/Patient\\_Safety\\_Alert\\_-\\_Confirming\\_removal\\_or\\_flushing\\_of\\_lines\\_and\\_cannulae\\_of\\_EVC1Yb2.pdf](https://improvement.nhs.uk/documents/1922/Patient_Safety_Alert_-_Confirming_removal_or_flushing_of_lines_and_cannulae_of_EVC1Yb2.pdf)

Plagge, H., Golmick, J., Bornand, D., & Deuster, S. Evaluation of the dead volume in intravenous short-term infusion. 2010 EJHP Science Volume 16, Issue 2, P. 31-37

Shanmugam Sriram, S.A., Moithu, A., Sebastian, A. and Kumar, A., 2020. Intravenous drug incompatibilities in the intensive care unit of a tertiary care hospital in India: Are they preventable?. Journal of Research in Pharmacy Practice, 9(2), p.106.

Thoele K, Piddoubny M, Ednalino R et al. Optimizing drug delivery of small-volume infusions. J Infusion Nurs 2018; 41(2):113–117. doi: 10.1097/NAN.000000000000268