NIVAS
National Infusion and Vascular Access Society

Intravenous Administration of Medicines to adults: Guidance on "IV-line flushing"

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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 3 (NIVAS 2021).

'IV-lines flushing' refers to the flushing of IV volumetric infusion sets and syringe extension lines. Flushing of IV cannulas for maintenance of patency and before and after the administration of medicines is not on the scope of this guideline.

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 sets, 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.

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 it varies depending on the type and length of the tube. Manufacturers will often state the 'priming volume' of an extension set (in mL) for both gravity and volumetric infusion pump sets. However, this priming volume often relates the total volume required to fill the infusion set to the centre of the drip chamber and is not the same as the residual volume remaining at the end of the infusion, when the infusion set is empty.

The actual volume that remains in infusion sets after administration may also vary depending on the type of set , and method of administration (gravity or via pump) (Harding *et al.,* 2020, Cooper *et al.*, 2018, Plagge *et al*., 2010).

The total 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). The dead space of IV extension lines for infusions of 50mL or less administered via a syringe pump is smaller, therefore represents a lower percentage of drug loss within the extension tubing and so could be a reliable alternative admiration method if residue drug loss was a concern.

Examples of approximate drug loss (calculated using and average dead space volume of 25mL for volumetric infusion sets and 2mL for syringe extension lines)::
- Ceftriaxone infusion in 50mL, the residual volume lost in the infusion set may be up to 50% when administered from a bag, but a lot lower, 4%, when given via a syringe extension line.

There are however cases when losses when administered from a syringe may be more significant:

- Furosemide 180mg in 18mL infusion given over 24 hours via syringe pump the volume lost in extension line would be 11%.

2. Flushing lines after infusing a medicine

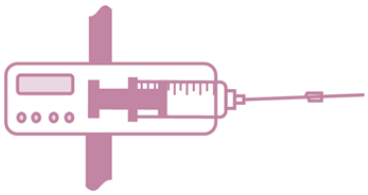
Fixed dose infusions are infusions where the **total dose** to administer over a number of hours is prescribed. These may be **intermittent infusions,** e.g. vancomycin 1g over 2 hours, or

continuous fix dose infusions, e.g. furosemide 180mg as a continuous infusion over 24 hours. The line should be flushed at the end of the infusion to ensure that the full dose is administered.

Variable rate infusions are those prescribed at a rate e.g. micrograms/Kg/minute. There is no total dose prescribed to administer and once the infusion is discontinued the infusion set can

Fixed dose infusions

Via syringe pump

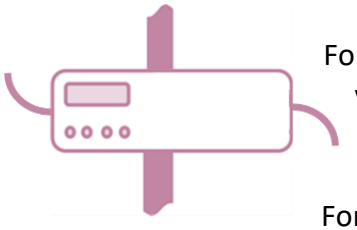


At the end of the infusion, disconnect the syringe from infusion set and connect a syringe containing a flush of sodium chloride 0.9% or a compatible diluent and infuse at the same rate as the previously administered medication, the flush volume should be enough to clear the line and the vascular access device. 10mls should be adequate to achieve this.

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 a compatible diluent, using one of the methods described below (2. Methods for flushing infusions administered from a bag).

Variable rate continuous infusions via syringe or volumetric pump



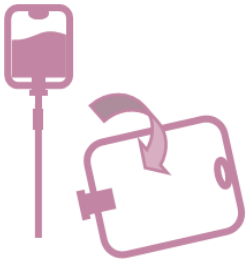
For variable rate continuous infusions administered through a **Central Venous Catheter (CVC),** discard the infusion set and aspirate the cannula contents *before* flushing with sodium chloride 0.9%.

For variable rate continuous infusions (e.g., vasoactive, strong sedatives or anaesthetic medicines) administered through a **Peripheral 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 the bolus effect. See below: Patient Safety Alert NHS/PSA/D/2017/006- Confirming removal or flushing of lines and cannula after procedure

be removed and discarded. It is important to remember that there will be still a residual volume of the medicines in the venous access catheter or cannula that will need to be either aspirated, of flushed at the same rate than the infusion (see below).

3. Methods for flushing infusions administered from a bag

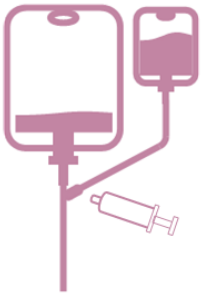
Method 1



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 residual 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.
6. Ensure vascular access device is flushed to remove drug residue.

Method 2



IV infusion sets with an additional port are available from specific companies. 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.

- Caution must be taken 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.
- Flush volumes must be accounted for in fluid balance records.
- Follow local prescribing guidelines for flushing solutions.

4. Risk associated with flushing

From residual volume of medicine in infusion sets

To avoid unintended push administration of medicine, from the residual medication 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

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.

5. Recommendations to healthcare organisations

This guidance should be read in conjunction with, and implementation should take into account Local injectable medicines policy and guidelines, including specialty-specific policies and associated education & training programmes

Local training and education should include importance of awareness amongst staff administering IV medicines of the risks of

- underdosing if residual medication in infusion sets is not flushed
- accidental push dosing if an inappropriate flushing technique is used
- The range of consumables and medical 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

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