

Questions have been grouped together based on their content or focus.

## **Aspirating a blood return from a catheter**

- ***Can we use CVC with no blood return?***
- ***If a CVAD has no blood return should studies be made to find out what is going on?***
- ***Can we use PICC without blood return?***
- ***Can a PICC be used without a blood return or intermittent blood return?***
- ***Is it necessary to obtain a blood return to determine placement before every flush?***
- ***When infusing multiple times in any given shift, is one check for blood return adequate?***

All catheters should produce a free flowing brisk blood return upon aspiration. This is a routine component of your assessment of catheter functionality for all types of catheters – peripheral, midline, and central venous catheters. The complete assessment should include aspiration, flushing to determine resistance, palpation of the insertion site (especially for a peripheral catheter), and paying close attention to any patient complaints during this assessment.

There are two places in the Infusion Nursing Standards of Practice that addresses this:

- Standard 50 Flushing, Practice Criteria N. “The nurse should aspirate the catheter for positive blood return to confirm patency prior to administration of medications and solutions.”
- Standard 68 Parenteral Medication and Solution Administration, Practice Criteria A. The same statement is repeated.

This issue is also addressed in the Chemotherapy and Biotherapy Guidelines and Recommendations for Practice from the Oncology Nursing Society. They state that all peripheral and central venous catheters should be assessed for patency by aspirating for a positive blood return. They go on to provide information about what to teach the patient about delaying therapy because a blood return is not present.

There are no recommendations stating that aspiration is only necessary in a given period of time. Each catheter use requires a thorough assessment of patency. There are numerous reports of infiltration and extravasation injury when no blood return was obtained or when this assessment was not performed.

***Doesn't checking for blood return (especially in PICCs) increase risk of occlusion by lining the entire catheter with blood? The catheter shouldn't dislocate.***

When all catheters are inserted, blood is aspirated to determine that the operator has entered the vein. This means that the catheter will have serum proteins on the internal lumen from the first moments of insertion. There is no evidence that aspiration to assess patency increases the risk of catheter occlusion. Catheter dislodgment (movement into or out of the insertion site) or tip migration (tip movement to another vein without changes in external length) is not related to aspirating for a blood return.

***At our institution, we do not routinely use Cathflo® if we do not get a blood return- should we be using cathflo to get a blood return on all central lines without a blood return?***

Catheters without a blood return require additional assessment to determine the problem. A short peripheral catheter is flushed with saline while palpating and you should also be able to observe a rapid free-flowing gravity infusion without any alteration in the quality of fluid flow. Removal and insertion at another site is usually the best action if there is any question about the functionality of the catheter or vein.

A central venous catheter without a blood return poses a serious risk of infiltration and/or extravasation from a complete fibrin sheath, plus other complications involving catheter and vein damage. However the nurse at the bedside has no method to determine the exact cause of the absence of blood return. There may also be other causes such as tip migration to a smaller vein, catheter damage such as pinch-off syndrome, or disconnection of the catheter from the implanted port body. The cause could also be related to drug precipitate inside the lumen.

You need to perform a careful assessment of how the catheter has performed over its life. Has this been a slow gradual reduction in blood return or a sudden occurrence? Does the situation change when the patient changes position? Are there any unusual areas of edema, pain, or any type of discomfort at or near the insertion site? What fluids and medications have recently been infused? From this assessment, you can determine if an intraluminal thrombotic occlusion is the most likely cause and a thrombolytic agent is indicated.

If this is the mostly probably cause, there are 2 approaches that can be used. You can attempt a declotting procedure with a thrombolytic agent according to your organizational protocol or you can obtain a dye study through the catheter to determine the actual fluid flow pathway and rule out any other causes, followed by the thrombolytic agent if indicated.

- ***Blood return on home care patients? Should patients be taught to do this?***
- ***Is it worth checking for blood return in homecare catheters at the risk of introducing blood into line?***
- ***Does INS recommend teaching families to assess for a blood return on a central line in home care, and does this increase the risk of thrombosis, in the absence of daily monitoring of appropriate flushing technique?***
- ***In a home care setting, how frequently should a blood return be performed to check catheter patency?***

The statements from INS about obtaining a blood return are listed above and they do not address the issues of teaching patients to do this step in home care. There are definite concerns about having patient's aspirate a blood return before giving a medication in the home. While some home care companies may teach this, most have policies to have the nurse assess the catheter's patency by aspiration and flushing when they do a routine dressing change.

There is no evidence that performing aspiration to assess for a blood return increases the risk of venous thrombosis or catheter lumen occlusion from thrombotic causes. The catheter would only be aspirated immediately before each use. This is followed quickly with a saline flush to detect resistance and complete the assessment process. So this blood is not allowed to remain inside the catheter lumen.

***My question refers to slide 18, when to flush. If you have a continuous infusion via a CVAD, if you do not need to flush between bags, how can you assess complete patency of the catheter (ie: blood return)? Should you assess patency and flush between bag changes?***

If you are infusing a vesicant medication, it could be advisable to assess for a blood return at established intervals, however that interval has not been established. Most continuous infusions are regulated by an infusion pump, therefore occlusion alarms can be used to validate the absence of infusion occlusions.

***What about checking for blood return on the continuously infusing line, especially with TPN? I see many nurses never checking for blood return and want tPA to the other "problem" ports, when I believe the problem has begun in the unflushed TPN port.***

There is no evidence that the lumen receiving the TPN infusion produces problems as you have described. The TPN is infusing on a pump that is creating a constant fluid flow through the lumen. There is also no evidence that a problem in one lumen will be caused by what is happening in another lumen. Your problems in the lumen used intermittently is more likely related to the flushing technique used with the specific type of syringe and needleless connector.

## **Product related questions**

***What is the product name of the neutral displacement device with the internal pressure valve?  
Slide 31***

The product pictured on the slide is the Lifeshield TKO by Hospira.

***What pressure is the Clave, blue port?***

Clave<sup>®</sup>, (ICU Medical) was the first one-piece luer-activated mechanical valve introduced in the US. It is a negative fluid displacement device, indicating the need for positive pressure flushing technique. Pressure is not generated by any needleless connector.

***Any comment about needleless cap which "spit" a bit of flush when the syringe is disengaged?***

It sounds like you are describing the positive displacement needleless connectors. Many facilities have success with these devices when all staff are knowledgeable of and consistently practice the correct flushing technique. The traditional positive pressure flushing techniques cannot be used in these positive displacement connectors as these flushing techniques will prevent the positive displacement mechanism from functioning properly.

***I have been told that with some of the new positive pressure caps you do not necessarily need to use clamps; is that OK?***

First, these are **not** positive pressure caps. They are positive fluid displacement devices as there is no pressure generated from the displacement mechanisms.

Clamping is a routine part of the positive pressure flushing technique used with a negative displacement connector. When the clamp is applied before syringe disconnection on a positive displacement connector, it will prevent the positive displacement mechanism from working.

Many institutions and agencies believe that clamping the catheter provides protection from venous air emboli if the needleless connector were to become loosened or completely removed. Positive and neutral displacement devices can be clamped **after** syringe disconnection to enhance patient safety.

***Can you use positive displacement caps (MaxPlus) with valved catheters (Bard Power PICC Solo)?***

The instructions for use for this catheter contains the following statement:

**“The PowerPICC SOLO\* catheter is designed for use with needleless injection caps or ‘direct-to-hub’ connection technique. Apply a sterile end cap on the catheter hub to prevent contamination when not in use. Use of a needle longer than 1.6 cm may cause damage to the valve.”**

No additional information is available. You should contact Bard Access Systems to obtain a written answer to your specific question.

***Have you heard of any problems with flushing, clotting, or techniques specific to the new Bard Power PICC Solo Catheter?***

This catheter is relatively new to the US market; therefore there has not been sufficient time to have published studies available on its performance. You should follow the manufacturers instructions for use for all maintenance procedures.

Please remember that flushing procedures for all types and brands of catheters must be regarded as a system – the container where the flush solution is obtained, the syringe used for flushing, the needleless connector and the catheter itself. All components must work together. Changing one component alone without addressing all issues associated with catheter flushing may not alter your outcomes. For instance, syringe-induced blood reflux is often overlooked as a factor in catheter lumen occlusion.

***Split septum slide said 17.3%, is that correct on slide 43?***

This is the combined percentage for total and partial occlusions as reported in the study.

***I thought the data on positive displacement valves showed that they don't actually prevent reflux? Am I mistaken?***

Positive displacement needleless connectors overcome blood reflux by the internal fluid displacement mechanism. Blood reflux may occur but the fluid held in the device's reservoir overcomes this blood reflux pushing it out of the catheter lumen and back into the bloodstream.

***We seem to have a higher occlusion rate with home health, which use an extension with end cap.***

The extension set is not causing the problem. You did not state the type of end cap or needleless connector, type of syringe, or the flushing technique that is being used. All of these components must be chosen to work together as system.

***What about connecting PICC lines to VAMPs?***

I can only assume that you are referring to the devices placed in the external infusion administration set that is used to obtain frequent blood samples. It is my understanding that these devices can be used on all types of central venous catheters, although I am not familiar with the outcomes specifically with PICCs.

***How would a nurse know which type of pressure device is being utilized to know what method to use to flush?***

It is important to remember that these are **not** pressure devices. They are fluid displacement devices.

It is incumbent upon the organization to provide proper training on the type of needleless connector being used, along with the training on the correct flushing technique to use. Policies and procedures must be written to reflect the correct technique for the device in stock.

This can be a problem when multiple types of needleless connectors are being used. That is the reason for product standardization across the entire organization.

***Can PICC patency be maintained with just saline using positive displacement device?***

Yes, many organizations have success with saline only flushes in positive displacement devices **when** the correct flushing technique is being used. Outcome data should be tracked when products or techniques are changed. This data will show the level of risk for catheter complications produced by the change. If these complications (e.g., lumen occlusion, thrombolytic use, infection rates) are unacceptably high or trending upward, it should be addressed through appropriate avenues with your organization.

***Bionector® also -Neutral valve??***

Yes, this is another brand of a neutral displacement valve made by Vygon.

## Flush Solution Questions

- *Can you use saline for tunneled or pheresis catheters?*
- *Are there protocols for flushing implanted ports (e.g., mediports) with saline only?*
- *What do you think about flushing implanted ports with saline only?*
- *If an implanted port is accessed and the patient is receiving once a day medication, should the flushing be still 100 units heparin per 5 ml or can you move to saline only flush?*
- *Patient has implanted port - can we flush only N.S. via CLC2000 cap?*

There are brands of tunneled and pheresis catheters and implanted ports that have integral valves (e.g., Groshong, Bard Access Systems; PASV, Namic/Vascular Access, formerly Boston Scientific; LifeValve, Andiodynamics.) These catheters have instructions for use that state saline only is acceptable for catheter flushing.

If you are using a brand of catheter without these integral valves, you can add a needleless connector that also has saline-only flushing instructions. Ensure that you have obtained written instructions for the manufacturer about the solution they recommend for catheter flushing.

When an implanted port is accessed and being used for intermittent infusion therapy, you should add the chosen needleless connector used in your organization and use the appropriate flushing technique indicated for that needleless connector.

As with any catheter, you must ensure that the proper flushing techniques are being used for the brand of needleless connector in use. If using a traditional syringe, do not flush all fluid from the syringe, as this will cause syringe-induced reflux.

When an implanted port is de-accessed, most facilities continue to use heparin as the final locking solution. However, implanted ports with integral valves can be flushed with saline only upon removal of the access needle. Follow the specific manufacturers instructions for use for each brand of implanted port. This information can often be found at the manufacturers website or by calling the company.

### ***When using a negative displacement device on a midline catheter do you suggest the use of heparin for flushing?***

When a negative displacement device is used on a midline and all central venous catheters, heparin lock solution is the preferred solution to use as the final flush. In patients where heparin is contraindicated (e.g., heparin-induced thrombocytopenia), an alternative solution may be required. The last presentation in this series will address the evidence about alternative locking solutions.

## Flushing Technique Questions

- *We use a positive pressure cap on our lines and have been instructed not to clamp after flushing what is your view?*
- *What flushing technique would you recommend with a positive displacement device? Flush, disconnect then clamp the catheter.*

There are **no** positive pressure caps; they are positive displacement devices. Clamping may be necessary for patient safety due to the risk of venous air emboli if the needleless connector were to come off the catheter hub. Clamping of a positive displacement connector is possible **after** the syringe is disconnected.

***So, no matter how great our techniques, we may expect about 25% thrombotic/no blood return from central lines?***

This is the most frequently reported statistic for **all** thrombotic causes of occlusion. But remember that this number does not distinguish between intraluminal and intravenous problems. The cause of the occlusion could easily be related to the catheter's tip location and many patient-related factors. The techniques or technology being used will have **no** impact on these factors.

***Do clamps need to be used if a negative pressure valve is placed on the ports of a PICC line, mainly power PICCs?***

These needleless connectors are **not** pressure generating devices. When using a negative displacement device, you must use one of the two positive pressure flushing techniques as discussed in the presentation. This is true with all types, brands, and sizes of catheters.

***Please confirm: no "stop/start" flush w/ positive displacement device?***

This type of flushing technique was not intended to have any impact on the reflux of blood caused by syringe disconnection from the catheter hub. The turbulent flushing technique originated long before the controversy over these needleless connectors. The theory behind this flushing technique is to "clean" the catheter walls of any blood or blood components that adhere to the catheter walls. As I explained, it might be beneficial for immediate removal of whole blood that was aspirated into the catheter, but it is unlikely that this technique will actually remove any of the fibrin that is firmly attached to the catheter walls.

The turbulent technique can be used with either of the positive pressure flushing techniques or it can be used when a positive displacement connector is being used. However we do not have any data to support the outcomes with its use with any type of catheter or needleless connector.

***I just had a Vascath® that aspirated blood very well, but when flushed, it was totally occluded. What could have caused that?***

I cannot make a complete assessment without more information. What vein was used for insertion? If subclavian, you could be dealing with pinch-off syndrome. Did the patient arm change position in any way while you were flushing? The patient would need a chest xray to identify the compressed catheter. But make sure you tell the radiology department what you suspect because the patient positioning is different than a regular chest xray.

It could also be related to the catheter impinging on the vein wall. Was it a right or left sided insertion? Left sided insertions have a greater chance of abutting the right wall of the superior vena cava.

***When flushing do you aspirate out the heparin first or do you flush the heparin in and then reflush with normal saline and heparin?***

For all CVCs the heparin is flushed in with saline. The heparin concentration would either be 10 or 100 units per mL. The concept of aspirating the heparin comes from hemodialysis catheters where they are locked with very high doses of heparin such as 1000 units per mL or more.

***I have been flushing PICC lines, which have a split septum cap, using flushing and clamping the lumen, while still flushing, then removing the syringe. Am I doing it right?***

That procedure should be sufficient to prevent blood reflux with a split septum connector.

***Isn't the infusing while withdrawing type of flush hazardous to the nurse due to aerosolization?***

This technique will result in a spray of fluid on the outside of the needleless connector. The nurse must be using gloves with this technique. There is no evidence about how far the droplets from this procedure may spread. If you have concerns about it, you can always use the other positive pressure flushing technique of flushing, hold the syringe plunger in place, close the clamp, and then disconnect the syringe. Remember this would be appropriate for use on a negative displacement connector only.

## **Flush Solution Volume Questions**

- ***Can we use the same recommended volumes to flush TPN or blood withdrawal?***
- ***How much NSS do you recommend using post TPN w/ lipids infusion?***

All these fluids are viscous and it could be beneficial to flush with at least 10 mL of normal saline. Some policies call for using 20 mL of normal saline after blood sampling. There are no studies to demonstrate better outcomes with either volume.

***Is there any additional recommendation in terms of saline volume for flushing either central or peripheral catheters in patients with sodium restrictions?***

I have never seen an alteration in catheter flushing regimen for patients on a dietary sodium restriction. Usually these diets called for a limitation to 2 or 3 grams of sodium chloride daily.

A liter of normal saline contains 154 mEq of sodium and 154 mEq of chloride per liter. For a 10 mL flush of normal saline this would equal 1.54 mEq of each per flush. 1 mEq of sodium = approximately 23 milligrams of sodium by weight. So a 10 mL saline flush would deliver about 35 milligrams of sodium, an extremely small amount.

The instructions for use from one brand of prefilled saline syringes states that the each mL contains 9 milligrams of sodium chloride. This would be a total of 90 mg of sodium and chloride in a 10 mL flush. Alteration in flushing protocols could be necessary if frequent doses of medication were required in a patient with severe dietary restrictions.

***How much NSS flush do you recommend on an adult CVC following blood return?***

There are no studies that have established an exact amount. It ranges from 3 to 10 mL. Most organizations established a procedure of 5 or 10 mL before and after each intermittent catheter use.

***Are there any preservative free pre-filled saline flushes available?***

All prefilled syringes that I know of are preservative free. The preservative is only contained in a multiple dose vial.

***For what reason would you need to use bacteriostatic saline?***

There are no catheter-related reasons for using bacteriostatic saline. If you are using a multiple dose vial as the source of saline for catheter flushing, these vials will contain the bacteriostatic agent benzyl alcohol.

## **Frequency of Flush Questions**

***We are in home health and are seeing infusion centers flush PICC lines weekly with saline only. Do you have a comment on that?***

Ambulatory infusion centers are flushing the catheters after each use, and often this is only once per week. The flushing frequency varies between each care setting. There are no studies on flushing frequency, except the one discussed about peripheral catheters. See #11 on the reference list.

***In the studies comparing saline and heparin flushes there is no mention of frequency of flushing. My sense is since they are hospital based they are minimally flushed q8hrs, this is not routinely practiced in the home environment where daily flushing is the practice for maintenance. Is it appropriate to flush a catheter weekly only with saline if the patient is not receiving active therapy and you are using a positive pressure displacement valve?***

There are **no** positive pressure valves; they are positive displacement devices. There are differences in practice between each care setting. These differences have not been studied, so there are no evidence-based answers to your questions. You should follow the instructions for the specific brand of positive displacement connector being used.

***How often and with what do you advise flushing accessed implanted ports being used intermittently?***

They should be flushed after each intermittent use. This could be every 24 hours or every 4 hours depending upon the therapy prescribed.

You should always flush with saline 5 to 10 mL first to assess patency after obtaining a positive blood return. Then administer the medication. This is followed by 5 to 10 mL of normal saline.

If using a negative displacement connector, you would follow with 3 to 5 mL of heparin using a positive pressure flushing technique. I have always used 10 units per mL of heparin on all types of central venous catheters, including accessed implanted ports.

If you are using a positive or a neutral displacement connector, you must follow the manufacturer's instructions about heparin use. Many have instructions for saline only, but some do not. The standard of practice would be to follow those instructions.

***Do you think q 4 hour saline flushes prevents PICCs from blocking?***

No, there is no evidence to support a routine flush of any catheter every 4 hours to prevent any type of occlusion. It does not appear to be the flushing frequency that increases patency but rather it is a matter of using the correct flushing technique based on the syringe, catheter and needleless connector being used.

In fact, flushing every 4 hours will only add to catheter hub manipulation and increase the risk of catheter-associated bloodstream infection. So flush after each intermittent use. When a catheter or lumen is not being used routinely, it is flushed every 12 hours in hospitals. But ambulatory and home care may only be flushing after use every 24 hours or even every week.

***If your central/PICC line were running at 15 ml/hr would it be beneficial to flush on a routine basis?***

That would depend upon the type of fluid being infused. If it is a vesicant medication, you may want to aspirate for a brisk blood return and flush with each change of the fluid container to assess catheter patency.

If the fluid is not a vesicant, and the infusion pump is not sounding any alarms, I would have a scheduled time to aspirate and flush when a fluid container is changed. If the pump is alarming, aspiration and flushing may be necessary to determine the cause of the alarms.

Of course, I am assuming that a flow rate such as this example would be on an infusion pump and it would be a therapeutic medication of some type. However, if you were referring to this flow rate as a keep-vein open fluid, I would immediately stop this fluid, and convert the catheter to an intermittent use only. There is no flow rate that will magically “keep a vein open”. A KVO order without a patient specific rate is not a legal physician order. Finally tethering a patient to a pump and tubing will hinder their progress with ambulation and delay discharge.

## Syringe related Questions

- ***Does barrel size matter, for instance if there is a prefilled 3cc syringe with the same barrel size of our 10cc, when filled with 3cc. Is this the same principle?***
- ***In regards to PSI is it the same with a 3cc prefilled syringe that is the same barrel diameter as a 10cc syringe filled to 3cc's?***
- ***Is the diameter of a syringe the same as the ml of the syringe? So can we use a 3ml 10 diameter syringe to flush a cvc?***

There is one brand of syringes that is designed to prevent syringe-induced reflux and it has an altered barrel size. This is the Posi-flush syringe from BD Medical. A 3 mL Posi-flush syringe with a 3 mL fill volume exerts the same amount of pressure as the standard 10 mL syringe.

***For flushing: a sale rep told me we shouldn't use 20 cc syringe for flushing, is it true?***

No it is not true. The basic principle is that larger syringes generate less pressure on injection. So a 20 mL syringe would be fine for flushing. Always expect to see everything in writing when a sale representative makes a statement. Anything that is stated by a person representing a product manufacturer is considered by the FDA to be labeling. They should not be making any claims outside of what they can produce in writing.

***Is it necessary to use a 20 ml syringe when flushing with 10mls NS?***

No, see above answer.

***Is the peripheral as well as central flushing syringe size recommended to be 10 ml? Sounds like it should be***

No. The issue with syringe size is catheter damage. Short peripheral catheters can tolerate the pressure generated by high-pressure injectors used in radiology. These may go as high as 300 psi. Most central venous catheters cannot tolerate high pressures unless they are made of polyurethane and labeled for use with high pressure injectors.

Syringe size is not the only factor to be considered. The formula is:  
force applied to the syringe plunger + resistance along the fluid pathway = internal pressure.

When the force is excessive (e.g., large, strong hand) and there is resistance in the catheter lumen or at the tip, you can generate enough internal pressure to cause catheter damage, regardless of the syringe size in use.

A 10 mL syringe will generate less pressure than a 3 mL syringe on injection but you can damage a catheter even with a 10 mL syringe if enough force is applied. So if you meet resistance, always stop and investigate the cause of that resistance before you proceed.

***What is the evidence to support syringe plunger rod compression. This question was asked recently during a discussion on care of umbilical lines and why double lumens are clotting when heparinized.***

The evidence is from in vitro or lab studies conducted by syringe manufacturers. This is very easy to demonstrate by using colored water in a catheter. Your catheters may be clotting because of syringe-induced reflux, the incorrect flushing technique being used with the needleless connector or for many patient related reasons.

***Please comment on the application and efficacy of the 3 syringes, which avoid rod compression action; worth using to avoid reflux and occlusion to flush NS only?***

A traditional syringe was never designed with catheter flushing in mind. As stated above, it is easy to demonstrate syringe-induced reflux. There are no clinical studies on any of these brands of prefilled syringes yet, however I strongly believe a terminally sterile prefilled syringe with this altered design is the best practice.

## **Fluid containers for flush solutions**

***Is it all right to use a multi-dose vial of heparin lock solution for several uses on the same patient?***

Maybe! If you are talking about home care patients where there is no chance that this vial will be used on another patient. And the patient/family have demonstrated great aseptic technique. Otherwise the risk is far too great.

***Is prefilled syringe a common practice in most of the hospitals?***

While I know their use is growing, I cannot answer about the practice in most hospitals.

***In acute care arena; 1000 ml bags of NS are used to flush the med lock post injection of contrast media. while using the contrast injector pump. Should the flush be a single use (50 or 100 mls ) bag or is the large bag okay if changed every 24 hours.***

When I first read your question, I heard serious alarm bells! So I want to make sure I understand your question. Are you placing a 1000 mL bag of normal saline with the tubing attached on an injector pump and moving this same bag and tubing between multiple patients? If so, you are practicing a serious violation of all known infection

control practices. This is the most dangerous thing you could be doing. There are no components of any IV system – fluid container, tubing, syringe, needles, needleless connectors, etc – that should ever be connected to multiple patients.

There are hospitals that will use these bags of IV fluids and attach a new sterile syringe to aspirate the 10 mL of normal saline for a catheter flush. This is not acceptable according to the statement from Morbidity and Mortality Weekly Report. There have been numerous outbreaks of infectious epidemics with this practice.

All supplies used should be totally dedicated to that patient and immediately discarded after use.

Please let me know if I have misunderstood your question.

## **Pediatric and Neonatal Questions**

***What is the most updated recommendation regarding neonates and pediatrics and heparin flushing? Any specific pediatric/infant recommendations?***

The volume of saline for flushing ranges between 1 to 3 mL for short peripheral catheters in all neonatal and pediatric patients.  
For central venous catheters, the volume of saline ranges between 3 to 5 mL, depending upon the catheter's fill volume and the age of the child.  
Heparin 10 units per mL is preferred for locking all types of central venous catheters and the volume would be twice the catheter's interval priming volume, usually about 1 mL for neonates. The possible exception to this would be using 100 units per mL for a monthly access of an implanted port in pediatrics.

***Is there a standard pediatric heparin dose for PICC lines ?***

The most commonly used dose of heparin lock solution in all central venous catheters including PICCs is 10 units per mL.

***Is there a minimum IV rate for infusions in central VAD that you do not recommend heparin added i.e NIU infusion at 0.5ml/hr vs 3 ml/hr, etc***

There is no data on a minimum rate that will maintain patency on any catheter in any age with or without heparin.

There is one study in a neonatal population comparing a continuous infusion of heparin 0.5 units per kg per hour to an infusion of 5% or 10% dextrose through PICCs. PICCs with the heparin infusion remained functional for a longer period than those receiving the dextrose.

## Organizational Policy Questions

***Do you recommend flush via MD orderset or through agency policy of INS based  
Since flushes are a legend item, should they not require a patient specific flush order?***

The answer to these questions depends upon whether you work in a hospital or home care. My experience is in hospitals where we always worked from established policies and procedures. A committee of physicians and nurses (e.g., Pharmacy and Therapeutics, etc) approved the written documents and then this became the accepted practice for the entire facility. In this situation each physician does not write a patient specific order for how to flush the catheter.

Having a set of pre-printed orders can be extremely helpful to ensure that all nurses are following the established protocols and to make sure that pharmacy knows which patients need what solutions for catheter flushing. This set of orders also means that these flushes will be printed on the Medication Administration Record, enhancing the compliance with proper documentation of all flushes.

In home care, physicians are expected to write patient-specific orders, however this requirement is due to state pharmacy laws. Most infusion pharmacies are licensed as retail outlets and must follow these laws. Every drug or device with the "legend" statement must have a patient-specific label with drug name, dose, frequency, quantity, and use. The legend statement is, "Caution: Federal law restricts this device to sale by or on the order of a (licensed healthcare practitioner)." A product may simply state "Rx Only" and still be within the required requirements for labeling.

The requirement to follow these laws does not prevent a home care pharmacy from establishing flushing protocols. A standard prescription form could contain these flushing protocols, thus providing a "prescription" from the licensed healthcare practitioner.

## Other

***Are there any studies, which discuss if the material the catheter is made out of changes rates of occlusion or fibrin production?***

Many years ago, there were serious debates and many studies comparing thrombosis rates with silicone versus polyurethane. There was never a dominant study adequately showing superiority of one over the other. Fibrin will develop on all catheters regardless of the material because it is a foreign object in the patient's bloodstream.

***Is an EJ medlock considered central line?***

By EJ, I think you are referring to the external jugular vein. "Medlock" is apparently a tradename that I am not familiar with. A central line is defined as a catheter whose tip

resides in the lower portion of the superior vena cava at or near its junction with the right atrium.

***We used to place heat on all PICC lines for the first 24 hrs after insertion and this practice has been said to be unnecessary, but wouldn't this practice decrease the production of both mechanical phlebitis & the adherence of fibrin due to increase blood flow and enlarging the vein lumen from the heat?***

The practice of heat application after PICC insertion began when PICC insertion began in the mid-1970's. The purpose was to reduce the incidence of mechanical phlebitis or to prevent it from occurring. Now that PICCs are placed above the antecubital fossa, the incidence of mechanical phlebitis is not as great.

Heat application was not then, nor could it ever be used for the purpose of decreasing fibrin adherence to the catheter. This is the body's natural response to the foreign object. Heat and lumen diameter cannot prevent fibrin deposits on any catheter. The catheter's outer diameter, however, must be carefully chosen to prevent it from consuming the vein lumen. This will increase the trauma to the tunica intima, cause endothelial disruption and thus increase thrombosis. But fibrin will develop on all catheters.

***Continuous infusion with IV pump DOES prevent occlusions with thrombus or not?***

Continuous infusion on an electronic infusion pump usually creates positive forward movement of fluid inside the catheter and may prevent blood reflux. However this depends upon the pumping mechanism of each pump. There could be small amounts of blood reflux during brief cycles of the pumping mechanism, but this would be followed quickly by fluid flow.

An infusion pump will have no impact on what is happening inside the vein around the catheter tip. There can easily be thrombus formation that leads to occlusion alarms on the pump.

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- ***Is it necessary to obtain a blood return to determine placement before every flush?***
- ***When infusing multiple times in any given shift, is one check for blood return adequate?***

All catheters should produce a free flowing brisk blood return upon aspiration. This is a routine component of your assessment of catheter functionality for all types of catheters – peripheral, midline, and central venous catheters. The complete assessment should include aspiration, flushing to determine resistance, palpation of the insertion site (especially for a peripheral catheter), and paying close attention to any patient complaints during this assessment.

There are two places in the Infusion Nursing Standards of Practice that addresses this:

- Standard 50 Flushing, Practice Criteria N. “The nurse should aspirate the catheter for positive blood return to confirm patency prior to administration of medications and solutions.”
- Standard 68 Parenteral Medication and Solution Administration, Practice Criteria A. The same statement is repeated.

This issue is also addressed in the Chemotherapy and Biotherapy Guidelines and Recommendations for Practice from the Oncology Nursing Society. They state that all peripheral and central venous catheters should be assessed for patency by aspirating for a positive blood return. They go on to provide information about what to teach the patient about delaying therapy because a blood return is not present.

There are no recommendations stating that aspiration is only necessary in a given period of time. Each catheter use requires a thorough assessment of patency. There are numerous reports of infiltration and extravasation injury when no blood return was obtained or when this assessment was not performed.

***Doesn't checking for blood return (especially in PICCs) increase risk of occlusion by lining the entire catheter with blood? The catheter shouldn't dislocate.***

When all catheters are inserted, blood is aspirated to determine that the operator has entered the vein. This means that the catheter will have serum proteins on the internal lumen from the first moments of insertion. There is no evidence that aspiration to assess patency increases the risk of catheter occlusion. Catheter dislodgment (movement into or out of the insertion site) or tip migration (tip movement to another vein without changes in external length) is not related to aspirating for a blood return.

***At our institution, we do not routinely use Cathflo® if we do not get a blood return- should we be using cathflo to get a blood return on all central lines without a blood return?***

Catheters without a blood return require additional assessment to determine the problem. A short peripheral catheter is flushed with saline while palpating and you should also be able to observe a rapid free-flowing gravity infusion without any alteration in the quality of fluid flow. Removal and insertion at another site is usually the best action if there is any question about the functionality of the catheter or vein.

A central venous catheter without a blood return poses a serious risk of infiltration and/or extravasation from a complete fibrin sheath, plus other complications involving catheter and vein damage. However the nurse at the bedside has no method to determine the exact cause of the absence of blood return. There may also be other causes such as tip migration to a smaller vein, catheter damage such as pinch-off syndrome, or disconnection of the catheter from the implanted port body. The cause could also be related to drug precipitate inside the lumen.

You need to perform a careful assessment of how the catheter has performed over its life. Has this been a slow gradual reduction in blood return or a sudden occurrence? Does the situation change when the patient changes position? Are there any unusual areas of edema, pain, or any type of discomfort at or near the insertion site? What fluids and medications have recently been infused? From this assessment, you can determine if an intraluminal thrombotic occlusion is the most likely cause and a thrombolytic agent is indicated.

If this is the mostly probably cause, there are 2 approaches that can be used. You can attempt a declotting procedure with a thrombolytic agent according to your organizational protocol or you can obtain a dye study through the catheter to determine the actual fluid flow pathway and rule out any other causes, followed by the thrombolytic agent if indicated.

- ***Blood return on home care patients? Should patients be taught to do this?***
- ***Is it worth checking for blood return in homecare catheters at the risk of introducing blood into line?***
- ***Does INS recommend teaching families to assess for a blood return on a central line in home care, and does this increase the risk of thrombosis, in the absence of daily monitoring of appropriate flushing technique?***
- ***In a home care setting, how frequently should a blood return be performed to check catheter patency?***

The statements from INS about obtaining a blood return are listed above and they do not address the issues of teaching patients to do this step in home care. There are definite concerns about having patient's aspirate a blood return before giving a medication in the home. While some home care companies may teach this, most have policies to have the nurse assess the catheter's patency by aspiration and flushing when they do a routine dressing change.

There is no evidence that performing aspiration to assess for a blood return increases the risk of venous thrombosis or catheter lumen occlusion from thrombotic causes. The catheter would only be aspirated immediately before each use. This is followed quickly with a saline flush to detect resistance and complete the assessment process. So this blood is not allowed to remain inside the catheter lumen.

***My question refers to slide 18, when to flush. If you have a continuous infusion via a CVAD, if you do not need to flush between bags, how can you assess complete patency of the catheter (ie: blood return)? Should you assess patency and flush between bag changes?***

If you are infusing a vesicant medication, it could be advisable to assess for a blood return at established intervals, however that interval has not been established. Most continuous infusions are regulated by an infusion pump, therefore occlusion alarms can be used to validate the absence of infusion occlusions.

***What about checking for blood return on the continuously infusing line, especially with TPN? I see many nurses never checking for blood return and want tPA to the other "problem" ports, when I believe the problem has begun in the unflushed TPN port.***

There is no evidence that the lumen receiving the TPN infusion produces problems as you have described. The TPN is infusing on a pump that is creating a constant fluid flow through the lumen. There is also no evidence that a problem in one lumen will be caused by what is happening in another lumen. Your problems in the lumen used intermittently is more likely related to the flushing technique used with the specific type of syringe and needleless connector.

## **Product related questions**

***What is the product name of the neutral displacement device with the internal pressure valve?  
Slide 31***

The product pictured on the slide is the Lifeshield TKO by Hospira.

***What pressure is the Clave, blue port?***

Clave<sup>®</sup>, (ICU Medical) was the first one-piece luer-activated mechanical valve introduced in the US. It is a negative fluid displacement device, indicating the need for positive pressure flushing technique. Pressure is not generated by any needleless connector.

***Any comment about needleless cap which "spit" a bit of flush when the syringe is disengaged?***

It sounds like you are describing the positive displacement needleless connectors. Many facilities have success with these devices when all staff are knowledgeable of and consistently practice the correct flushing technique. The traditional positive pressure flushing techniques cannot be used in these positive displacement connectors as these flushing techniques will prevent the positive displacement mechanism from functioning properly.

***I have been told that with some of the new positive pressure caps you do not necessarily need to use clamps; is that OK?***

First, these are **not** positive pressure caps. They are positive fluid displacement devices as there is no pressure generated from the displacement mechanisms.

Clamping is a routine part of the positive pressure flushing technique used with a negative displacement connector. When the clamp is applied before syringe disconnection on a positive displacement connector, it will prevent the positive displacement mechanism from working.

Many institutions and agencies believe that clamping the catheter provides protection from venous air emboli if the needleless connector were to become loosened or completely removed. Positive and neutral displacement devices can be clamped **after** syringe disconnection to enhance patient safety.

***Can you use positive displacement caps (MaxPlus) with valved catheters (Bard Power PICC Solo)?***

The instructions for use for this catheter contains the following statement:

**“The PowerPICC SOLO\* catheter is designed for use with needleless injection caps or ‘direct-to-hub’ connection technique. Apply a sterile end cap on the catheter hub to prevent contamination when not in use. Use of a needle longer than 1.6 cm may cause damage to the valve.”**

No additional information is available. You should contact Bard Access Systems to obtain a written answer to your specific question.

***Have you heard of any problems with flushing, clotting, or techniques specific to the new Bard Power PICC Solo Catheter?***

This catheter is relatively new to the US market; therefore there has not been sufficient time to have published studies available on its performance. You should follow the manufacturers instructions for use for all maintenance procedures.

Please remember that flushing procedures for all types and brands of catheters must be regarded as a system – the container where the flush solution is obtained, the syringe used for flushing, the needleless connector and the catheter itself. All components must work together. Changing one component alone without addressing all issues associated with catheter flushing may not alter your outcomes. For instance, syringe-induced blood reflux is often overlooked as a factor in catheter lumen occlusion.

***Split septum slide said 17.3%, is that correct on slide 43?***

This is the combined percentage for total and partial occlusions as reported in the study.

***I thought the data on positive displacement valves showed that they don't actually prevent reflux? Am I mistaken?***

Positive displacement needleless connectors overcome blood reflux by the internal fluid displacement mechanism. Blood reflux may occur but the fluid held in the device's reservoir overcomes this blood reflux pushing it out of the catheter lumen and back into the bloodstream.

***We seem to have a higher occlusion rate with home health, which use an extension with end cap.***

The extension set is not causing the problem. You did not state the type of end cap or needleless connector, type of syringe, or the flushing technique that is being used. All of these components must be chosen to work together as system.

***What about connecting PICC lines to VAMPs?***

I can only assume that you are referring to the devices placed in the external infusion administration set that is used to obtain frequent blood samples. It is my understanding that these devices can be used on all types of central venous catheters, although I am not familiar with the outcomes specifically with PICCs.

***How would a nurse know which type of pressure device is being utilized to know what method to use to flush?***

It is important to remember that these are **not** pressure devices. They are fluid displacement devices.

It is incumbent upon the organization to provide proper training on the type of needleless connector being used, along with the training on the correct flushing technique to use. Policies and procedures must be written to reflect the correct technique for the device in stock.

This can be a problem when multiple types of needleless connectors are being used. That is the reason for product standardization across the entire organization.

***Can PICC patency be maintained with just saline using positive displacement device?***

Yes, many organizations have success with saline only flushes in positive displacement devices **when** the correct flushing technique is being used. Outcome data should be tracked when products or techniques are changed. This data will show the level of risk for catheter complications produced by the change. If these complications (e.g., lumen occlusion, thrombolytic use, infection rates) are unacceptably high or trending upward, it should be addressed through appropriate avenues with your organization.

***Bionector® also -Neutral valve??***

Yes, this is another brand of a neutral displacement valve made by Vygon.

## Flush Solution Questions

- *Can you use saline for tunneled or pheresis catheters?*
- *Are there protocols for flushing implanted ports (e.g., mediports) with saline only?*
- *What do you think about flushing implanted ports with saline only?*
- *If an implanted port is accessed and the patient is receiving once a day medication, should the flushing be still 100 units heparin per 5 ml or can you move to saline only flush?*
- *Patient has implanted port - can we flush only N.S.via CLC2000 cap?*

There are brands of tunneled and pheresis catheters and implanted ports that have integral valves (e.g., Groshong, Bard Access Systems; PASV, Namic/Vascular Access, formerly Boston Scientific; LifeValve, Andiodynamics.) These catheters have instructions for use that state saline only is acceptable for catheter flushing.

If you are using a brand of catheter without these integral valves, you can add a needleless connector that also has saline-only flushing instructions. Ensure that you have obtained written instructions for the manufacturer about the solution they recommend for catheter flushing.

When an implanted port is accessed and being used for intermittent infusion therapy, you should add the chosen needleless connector used in your organization and use the appropriate flushing technique indicated for that needleless connector.

As with any catheter, you must ensure that the proper flushing techniques are being used for the brand of needleless connector in use. If using a traditional syringe, do not flush all fluid from the syringe, as this will cause syringe-induced reflux.

When an implanted port is de-accessed, most facilities continue to use heparin as the final locking solution. However, implanted ports with integral valves can be flushed with saline only upon removal of the access needle. Follow the specific manufacturers instructions for use for each brand of implanted port. This information can often be found at the manufacturers website or by calling the company.

### ***When using a negative displacement device on a midline catheter do you suggest the use of heparin for flushing?***

When a negative displacement device is used on a midline and all central venous catheters, heparin lock solution is the preferred solution to use as the final flush. In patients where heparin is contraindicated (e.g., heparin-induced thrombocytopenia), an alternative solution may be required. The last presentation in this series will address the evidence about alternative locking solutions.

## Flushing Technique Questions

- *We use a positive pressure cap on our lines and have been instructed not to clamp after flushing what is your view?*
- *What flushing technique would you recommend with a positive displacement device? Flush, disconnect then clamp the catheter.*

There are **no** positive pressure caps; they are positive displacement devices. Clamping may be necessary for patient safety due to the risk of venous air emboli if the needleless connector were to come off the catheter hub. Clamping of a positive displacement connector is possible **after** the syringe is disconnected.

***So, no matter how great our techniques, we may expect about 25% thrombotic/no blood return from central lines?***

This is the most frequently reported statistic for **all** thrombotic causes of occlusion. But remember that this number does not distinguish between intraluminal and intravenous problems. The cause of the occlusion could easily be related to the catheter's tip location and many patient-related factors. The techniques or technology being used will have **no** impact on these factors.

***Do clamps need to be used if a negative pressure valve is placed on the ports of a PICC line, mainly power PICCs?***

These needleless connectors are **not** pressure generating devices. When using a negative displacement device, you must use one of the two positive pressure flushing techniques as discussed in the presentation. This is true with all types, brands, and sizes of catheters.

***Please confirm: no "stop/start" flush w/ positive displacement device?***

This type of flushing technique was not intended to have any impact on the reflux of blood caused by syringe disconnection from the catheter hub. The turbulent flushing technique originated long before the controversy over these needleless connectors. The theory behind this flushing technique is to "clean" the catheter walls of any blood or blood components that adhere to the catheter walls. As I explained, it might be beneficial for immediate removal of whole blood that was aspirated into the catheter, but it is unlikely that this technique will actually remove any of the fibrin that is firmly attached to the catheter walls.

The turbulent technique can be used with either of the positive pressure flushing techniques or it can be used when a positive displacement connector is being used. However we do not have any data to support the outcomes with its use with any type of catheter or needleless connector.

***I just had a Vascath® that aspirated blood very well, but when flushed, it was totally occluded. What could have caused that?***

I cannot make a complete assessment without more information. What vein was used for insertion? If subclavian, you could be dealing with pinch-off syndrome. Did the patient arm change position in any way while you were flushing? The patient would need a chest xray to identify the compressed catheter. But make sure you tell the radiology department what you suspect because the patient positioning is different than a regular chest xray.

It could also be related to the catheter impinging on the vein wall. Was it a right or left sided insertion? Left sided insertions have a greater chance of abutting the right wall of the superior vena cava.

***When flushing do you aspirate out the heparin first or do you flush the heparin in and then reflush with normal saline and heparin?***

For all CVCs the heparin is flushed in with saline. The heparin concentration would either be 10 or 100 units per mL. The concept of aspirating the heparin comes from hemodialysis catheters where they are locked with very high doses of heparin such as 1000 units per mL or more.

***I have been flushing PICC lines, which have a split septum cap, using flushing and clamping the lumen, while still flushing, then removing the syringe. Am I doing it right?***

That procedure should be sufficient to prevent blood reflux with a split septum connector.

***Isn't the infusing while withdrawing type of flush hazardous to the nurse due to aerosolization?***

This technique will result in a spray of fluid on the outside of the needleless connector. The nurse must be using gloves with this technique. There is no evidence about how far the droplets from this procedure may spread. If you have concerns about it, you can always use the other positive pressure flushing technique of flushing, hold the syringe plunger in place, close the clamp, and then disconnect the syringe. Remember this would be appropriate for use on a negative displacement connector only.

## **Flush Solution Volume Questions**

- ***Can we use the same recommended volumes to flush TPN or blood withdrawal?***
- ***How much NSS do you recommend using post TPN w/ lipids infusion?***

All these fluids are viscous and it could be beneficial to flush with at least 10 mL of normal saline. Some policies call for using 20 mL of normal saline after blood sampling. There are no studies to demonstrate better outcomes with either volume.

***Is there any additional recommendation in terms of saline volume for flushing either central or peripheral catheters in patients with sodium restrictions?***

I have never seen an alteration in catheter flushing regimen for patients on a dietary sodium restriction. Usually these diets called for a limitation to 2 or 3 grams of sodium chloride daily.

A liter of normal saline contains 154 mEq of sodium and 154 mEq of chloride per liter. For a 10 mL flush of normal saline this would equal 1.54 mEq of each per flush. 1 mEq of sodium = approximately 23 milligrams of sodium by weight. So a 10 mL saline flush would deliver about 35 milligrams of sodium, an extremely small amount.

The instructions for use from one brand of prefilled saline syringes states that the each mL contains 9 milligrams of sodium chloride. This would be a total of 90 mg of sodium and chloride in a 10 mL flush. Alteration in flushing protocols could be necessary if frequent doses of medication were required in a patient with severe dietary restrictions.

***How much NSS flush do you recommend on an adult CVC following blood return?***

There are no studies that have established an exact amount. It ranges from 3 to 10 mL. Most organizations established a procedure of 5 or 10 mL before and after each intermittent catheter use.

***Are there any preservative free pre-filled saline flushes available?***

All prefilled syringes that I know of are preservative free. The preservative is only contained in a multiple dose vial.

***For what reason would you need to use bacteriostatic saline?***

There are no catheter-related reasons for using bacteriostatic saline. If you are using a multiple dose vial as the source of saline for catheter flushing, these vials will contain the bacteriostatic agent benzyl alcohol.

## **Frequency of Flush Questions**

***We are in home health and are seeing infusion centers flush PICC lines weekly with saline only. Do you have a comment on that?***

Ambulatory infusion centers are flushing the catheters after each use, and often this is only once per week. The flushing frequency varies between each care setting. There are no studies on flushing frequency, except the one discussed about peripheral catheters. See #11 on the reference list.

***In the studies comparing saline and heparin flushes there is no mention of frequency of flushing. My sense is since they are hospital based they are minimally flushed q8hrs, this is not routinely practiced in the home environment where daily flushing is the practice for maintenance. Is it appropriate to flush a catheter weekly only with saline if the patient is not receiving active therapy and you are using a positive pressure displacement valve?***

There are **no** positive pressure valves; they are positive displacement devices. There are differences in practice between each care setting. These differences have not been studied, so there are no evidence-based answers to your questions. You should follow the instructions for the specific brand of positive displacement connector being used.

***How often and with what do you advise flushing accessed implanted ports being used intermittently?***

They should be flushed after each intermittent use. This could be every 24 hours or every 4 hours depending upon the therapy prescribed.

You should always flush with saline 5 to 10 mL first to assess patency after obtaining a positive blood return. Then administer the medication. This is followed by 5 to 10 mL of normal saline.

If using a negative displacement connector, you would follow with 3 to 5 mL of heparin using a positive pressure flushing technique. I have always used 10 units per mL of heparin on all types of central venous catheters, including accessed implanted ports.

If you are using a positive or a neutral displacement connector, you must follow the manufacturer's instructions about heparin use. Many have instructions for saline only, but some do not. The standard of practice would be to follow those instructions.

***Do you think q 4 hour saline flushes prevents PICCs from blocking?***

No, there is no evidence to support a routine flush of any catheter every 4 hours to prevent any type of occlusion. It does not appear to be the flushing frequency that increases patency but rather it is a matter of using the correct flushing technique based on the syringe, catheter and needleless connector being used.

In fact, flushing every 4 hours will only add to catheter hub manipulation and increase the risk of catheter-associated bloodstream infection. So flush after each intermittent use. When a catheter or lumen is not being used routinely, it is flushed every 12 hours in hospitals. But ambulatory and home care may only be flushing after use every 24 hours or even every week.

***If your central/PICC line were running at 15 ml/hr would it be beneficial to flush on a routine basis?***

That would depend upon the type of fluid being infused. If it is a vesicant medication, you may want to aspirate for a brisk blood return and flush with each change of the fluid container to assess catheter patency.

If the fluid is not a vesicant, and the infusion pump is not sounding any alarms, I would have a scheduled time to aspirate and flush when a fluid container is changed. If the pump is alarming, aspiration and flushing may be necessary to determine the cause of the alarms.

Of course, I am assuming that a flow rate such as this example would be on an infusion pump and it would be a therapeutic medication of some type. However, if you were referring to this flow rate as a keep-vein open fluid, I would immediately stop this fluid, and convert the catheter to an intermittent use only. There is no flow rate that will magically “keep a vein open”. A KVO order without a patient specific rate is not a legal physician order. Finally tethering a patient to a pump and tubing will hinder their progress with ambulation and delay discharge.

## Syringe related Questions

- ***Does barrel size matter, for instance if there is a prefilled 3cc syringe with the same barrel size of our 10cc, when filled with 3cc. Is this the same principle?***
- ***In regards to PSI is it the same with a 3cc prefilled syringe that is the same barrel diameter as a 10cc syringe filled to 3cc's?***
- ***Is the diameter of a syringe the same as the ml of the syringe? So can we use a 3ml 10 diameter syringe to flush a cvc?***

There is one brand of syringes that is designed to prevent syringe-induced reflux and it has an altered barrel size. This is the Posi-flush syringe from BD Medical. A 3 mL Posi-flush syringe with a 3 mL fill volume exerts the same amount of pressure as the standard 10 mL syringe.

***For flushing: a sale rep told me we shouldn't use 20 cc syringe for flushing, is it true?***

No it is not true. The basic principle is that larger syringes generate less pressure on injection. So a 20 mL syringe would be fine for flushing. Always expect to see everything in writing when a sale representative makes a statement. Anything that is stated by a person representing a product manufacturer is considered by the FDA to be labeling. They should not be making any claims outside of what they can produce in writing.

***Is it necessary to use a 20 ml syringe when flushing with 10mls NS?***

No, see above answer.

***Is the peripheral as well as central flushing syringe size recommended to be 10 ml? Sounds like it should be***

No. The issue with syringe size is catheter damage. Short peripheral catheters can tolerate the pressure generated by high-pressure injectors used in radiology. These may go as high as 300 psi. Most central venous catheters cannot tolerate high pressures unless they are made of polyurethane and labeled for use with high pressure injectors.

Syringe size is not the only factor to be considered. The formula is:  
force applied to the syringe plunger + resistance along the fluid pathway = internal pressure.

When the force is excessive (e.g., large, strong hand) and there is resistance in the catheter lumen or at the tip, you can generate enough internal pressure to cause catheter damage, regardless of the syringe size in use.

A 10 mL syringe will generate less pressure than a 3 mL syringe on injection but you can damage a catheter even with a 10 mL syringe if enough force is applied. So if you meet resistance, always stop and investigate the cause of that resistance before you proceed.

***What is the evidence to support syringe plunger rod compression. This question was asked recently during a discussion on care of umbilical lines and why double lumens are clotting when heparinized.***

The evidence is from in vitro or lab studies conducted by syringe manufacturers. This is very easy to demonstrate by using colored water in a catheter.

Your catheters may be clotting because of syringe-induced reflux, the incorrect flushing technique being used with the needleless connector or for many patient related reasons.

***Please comment on the application and efficacy of the 3 syringes, which avoid rod compression action; worth using to avoid reflux and occlusion to flush NS only?***

A traditional syringe was never designed with catheter flushing in mind. As stated above, it is easy to demonstrate syringe-induced reflux. There are no clinical studies on any of these brands of prefilled syringes yet, however I strongly believe a terminally sterile prefilled syringe with this altered design is the best practice.

## **Fluid containers for flush solutions**

***Is it all right to use a multi-dose vial of heparin lock solution for several uses on the same patient?***

Maybe! If you are talking about home care patients where there is no chance that this vial will be used on another patient. And the patient/family have demonstrated great aseptic technique. Otherwise the risk is far too great.

***Is prefilled syringe a common practice in most of the hospitals?***

While I know their use is growing, I cannot answer about the practice in most hospitals.

***In acute care arena; 1000 ml bags of NS are used to flush the med lock post injection of contrast media. while using the contrast injector pump. Should the flush be a single use (50 or 100 mls ) bag or is the large bag okay if changed every 24 hours.***

When I first read your question, I heard serious alarm bells! So I want to make sure I understand your question. Are you placing a 1000 mL bag of normal saline with the tubing attached on an injector pump and moving this same bag and tubing between multiple patients? If so, you are practicing a serious violation of all known infection

control practices. This is the most dangerous thing you could be doing. There are no components of any IV system – fluid container, tubing, syringe, needles, needleless connectors, etc – that should ever be connected to multiple patients.

There are hospitals that will use these bags of IV fluids and attach a new sterile syringe to aspirate the 10 mL of normal saline for a catheter flush. This is not acceptable according to the statement from Morbidity and Mortality Weekly Report. There have been numerous outbreaks of infectious epidemics with this practice.

All supplies used should be totally dedicated to that patient and immediately discarded after use.

Please let me know if I have misunderstood your question.

## **Pediatric and Neonatal Questions**

***What is the most updated recommendation regarding neonates and pediatrics and heparin flushing? Any specific pediatric/infant recommendations?***

The volume of saline for flushing ranges between 1 to 3 mL for short peripheral catheters in all neonatal and pediatric patients.  
For central venous catheters, the volume of saline ranges between 3 to 5 mL, depending upon the catheter's fill volume and the age of the child.  
Heparin 10 units per mL is preferred for locking all types of central venous catheters and the volume would be twice the catheter's interval priming volume, usually about 1 mL for neonates. The possible exception to this would be using 100 units per mL for a monthly access of an implanted port in pediatrics.

***Is there a standard pediatric heparin dose for PICC lines ?***

The most commonly used dose of heparin lock solution in all central venous catheters including PICCs is 10 units per mL.

***Is there a minimum IV rate for infusions in central VAD that you do not recommend heparin added i.e NIU infusion at 0.5ml/hr vs 3 ml/hr, etc***

There is no data on a minimum rate that will maintain patency on any catheter in any age with or without heparin.

There is one study in a neonatal population comparing a continuous infusion of heparin 0.5 units per kg per hour to an infusion of 5% or 10% dextrose through PICCs. PICCs with the heparin infusion remained functional for a longer period than those receiving the dextrose.

## Organizational Policy Questions

***Do you recommend flush via MD orderset or through agency policy of INS based  
Since flushes are a legend item, should they not require a patient specific flush order?***

The answer to these questions depends upon whether you work in a hospital or home care. My experience is in hospitals where we always worked from established policies and procedures. A committee of physicians and nurses (e.g., Pharmacy and Therapeutics, etc) approved the written documents and then this became the accepted practice for the entire facility. In this situation each physician does not write a patient specific order for how to flush the catheter.

Having a set of pre-printed orders can be extremely helpful to ensure that all nurses are following the established protocols and to make sure that pharmacy knows which patients need what solutions for catheter flushing. This set of orders also means that these flushes will be printed on the Medication Administration Record, enhancing the compliance with proper documentation of all flushes.

In home care, physicians are expected to write patient-specific orders, however this requirement is due to state pharmacy laws. Most infusion pharmacies are licensed as retail outlets and must follow these laws. Every drug or device with the "legend" statement must have a patient-specific label with drug name, dose, frequency, quantity, and use. The legend statement is, "Caution: Federal law restricts this device to sale by or on the order of a (licensed healthcare practitioner)." A product may simply state "Rx Only" and still be within the required requirements for labeling.

The requirement to follow these laws does not prevent a home care pharmacy from establishing flushing protocols. A standard prescription form could contain these flushing protocols, thus providing a "prescription" from the licensed healthcare practitioner.

## Other

***Are there any studies, which discuss if the material the catheter is made out of changes rates of occlusion or fibrin production?***

Many years ago, there were serious debates and many studies comparing thrombosis rates with silicone versus polyurethane. There was never a dominant study adequately showing superiority of one over the other. Fibrin will develop on all catheters regardless of the material because it is a foreign object in the patient's bloodstream.

***Is an EJ medlock considered central line?***

By EJ, I think you are referring to the external jugular vein. "Medlock" is apparently a tradename that I am not familiar with. A central line is defined as a catheter whose tip

resides in the lower portion of the superior vena cava at or near its junction with the right atrium.

***We used to place heat on all PICC lines for the first 24 hrs after insertion and this practice has been said to be unnecessary, but wouldn't this practice decrease the production of both mechanical phlebitis & the adherence of fibrin due to increase blood flow and enlarging the vein lumen from the heat?***

The practice of heat application after PICC insertion began when PICC insertion began in the mid-1970's. The purpose was to reduce the incidence of mechanical phlebitis or to prevent it from occurring. Now that PICCs are placed above the antecubital fossa, the incidence of mechanical phlebitis is not as great.

Heat application was not then, nor could it ever be used for the purpose of decreasing fibrin adherence to the catheter. This is the body's natural response to the foreign object. Heat and lumen diameter cannot prevent fibrin deposits on any catheter. The catheter's outer diameter, however, must be carefully chosen to prevent it from consuming the vein lumen. This will increase the trauma to the tunica intima, cause endothelial disruption and thus increase thrombosis. But fibrin will develop on all catheters.

***Continuous infusion with IV pump DOES prevent occlusions with thrombus or not?***

Continuous infusion on an electronic infusion pump usually creates positive forward movement of fluid inside the catheter and may prevent blood reflux. However this depends upon the pumping mechanism of each pump. There could be small amounts of blood reflux during brief cycles of the pumping mechanism, but this would be followed quickly by fluid flow.

An infusion pump will have no impact on what is happening inside the vein around the catheter tip. There can easily be thrombus formation that leads to occlusion alarms on the pump.