

## SYRINGE WITH DISINFECTING TIP FEATURE

### TECHNICAL FIELD

[0001] The present invention relates to syringe assemblies and particularly to syringe assemblies comprising a disinfecting reservoir collar to ensure adherence to aseptic techniques for use in flush procedures for vascular access devices (VAD's).

### BACKGROUND

[0002] VAD's are commonly used therapeutic devices and include intravenous (IV) catheters. There are two general classifications of VAD's, peripheral catheters and central venous catheters. To ensure VAD's are used and maintained correctly, standards of practice have been developed, which include a cleaning procedure, commonly referred to as flushing a catheter.

[0003] VAD standards of practice usually recommend that flush procedures be performed after catheter placement, before fluid infusion, and before and after drug administration, blood sampling, transfusions and parenteral nutrition. The goal of these flush procedures is to confirm catheter patency, avoid drug incompatibilities, ensure complete drug dose administration, prevent thrombus formation and minimize the risk of blood stream infections. Flush procedures require different types and amounts of flush solutions. The most commonly used flush solutions are saline and/or heparin lock solution. The type of flush solution and amount vary depending on the specific type of catheter. Flush solution volumes between 5 and 10 ml are most common but can range from 1 ml to 20 ml.

[0004] For flush procedures, an IV line refers to a system that can include a VAD, a tubing set with clamp and a VAD connector as a termination. Common types of VAD connectors are covered by pierceable septums or pre-slit septums made of rubber or another elastomeric material, which permits insertion of a sharp needle cannula in order to infuse fluids into or to withdraw fluids from the catheter. Upon withdrawal of the needle cannula, the septum seals itself. Ports having pre-slit septums are used with blunt plastic cannula or the frusto-conically shaped tip of a syringe barrel. The syringe tip or the blunt plastic cannula (which is usually attached to a syringe) is gently pushed through the pre-slit septum to establish fluid communication.

[0005] IV valves, another type of VAD connector that does not require a needle having a sharp tip, are activated by the frusto-conically shaped tip of a syringe barrel to allow fluid communication between the interior of the syringe and the catheter. These valves may contain features for delivering fluid from a storage compartment in the valve to the catheter, and are referred to in the art as positive displacement valves. Such a valve is taught in U.S. Pat. No. 6,206,861.

[0006] Bacteria and other microorganisms may gain entry into a patient's vascular system from access hubs and ports/valves upon connection to the VAD to deliver the fluid or pharmaceutical. Each access hub (or port/valve or connection) is associated with some risk of transmitting a catheter related bloodstream infection (CRBSI), which can be costly and potentially lethal.

[0007] Throughout the sequence of procedures associated with the transmission of a microorganism that can cause a CRBSI, there are many risks of contact or contamination. Contamination can occur during drug mixing, attachment of a cannula, and insertion into the access hub. Because the procedure to connect to a VAD is so common and simple, the risk associated with entry into a patient's vascular system has often been overlooked. Presently, the risk to hospitals and patients is a substantial function of the diligence of the clinician performing the connection, and this diligence is largely uncontrollable.

[0008] Current "recommended practice" for aseptic IV line maintenance and IV drug delivery practices require adherence to a stepwise process referred to as "SASH." During the first step of the process, the clinician cleans/disinfects (generally with an alcohol swab) the VAD connector. Second, a syringe containing saline is used to flush the IV line or catheter (Saline flush), and then the VAD connector is disinfected a second time. Third, the fluid or pharmaceutical therapy is administered through the IV line or catheter (Administer therapy), the VAD connector is disinfected a third time, followed by a second Saline flush step. The final step, which is dependent upon the patient's need and institutional policy, is a final disinfection of the VAD connector followed by a Heparin lock step, where a small amount of heparin is injected into the IV line or catheter to prevent the formation of thrombi or blood clots. At the conclusion of this tedious stepwise process, the inlet port of the VAD connector is left exposed to the environment. This "recommended practice" requires disinfecting the VAD connector after each step, and makes IV line maintenance a very burdensome and time consuming process. Because the process is so cumbersome, clinicians very rarely implement

this “recommended practice” in its entirety, and, thus, patients are exposed to the risk of contracting CRBSIs. Microorganisms populate exposed connector inlet surfaces, and, when the “recommended practice” is not adhered to, the microorganisms can enter the IV line during flushing. Furthermore, blood reflux into the IV line or catheter can cause clot formation inside the lines, and microorganisms from the connector inlet surfaces can colonize blood clots inside the lines and infect the patients during flushing.

[0009] A product currently available that aims to combat the problems associated with contaminated VAD connectors is the SwabCap®. This device disinfects a VAD connectors by covering the connector and protecting it from touch and airborne contamination after the cap has been applied. As the SwabCap® is twisted onto VAD connector, a foam pad inside the cap is compressed, releasing the isopropyl alcohol that bathes and passively disinfects the top and threads of the VAD connector while the cap is in place. Friction between the SwabCap® and VAD connector is essential to ensure proper swabbing and disinfecting as the twisting action helps focus the alcohol on the targeted areas. However, for several reasons, the SwabCap® falls short of accomplishing the desired goal of effectively cleaning and disinfecting the VAD connector. First, the caps do not always engage the threads on the catheter hub, so that friction during swabbing may be inefficient. Additionally, the caps are small, and thus, may result in touch contamination when they are being removed. Despite the fact that the caps are bright orange in color so that compliance can be visually confirmed, because the SwabCap® is a separate entity, only the most diligent clinician will utilize the cap after every step of the flush process. Thus, the cap does not ensure compliance with aseptic technique.

[0010] Substantial morbid and mortal risk is, therefore, associated with a number of routine procedures defined primarily by the uncontrollable diligence of the clinician administering the therapy. Unfortunately, the result is that a substantial degree of unnecessary risk and injury, in the form of CRBSIs, to patients occurs. There is a need, therefore, for a flush syringe assembly that promotes compliance with aseptic technique by eliminating the additional swabbing and disinfecting steps.

#### SUMMARY

[0011] Embodiments of the present invention are directed to a syringe assembly for use in flush applications. Syringe assemblies according to a first aspect of the present invention include a plunger rod, a syringe barrel, and a reservoir collar that permit disinfection of the

hub of a VAD connector upon connection to the device. The features providing for disinfection allow the clinician to substantially achieve the effects of aseptic techniques without the need for added swabbing steps and diligence on the part of the clinician.

[0012] In one or more embodiments, the disinfection is provided by a reservoir collar that contains a disinfectant housed within a compartment in the reservoir collar.

[0013] In one variant, the reservoir collar contains an absorbent material that surrounds a tip that is adapted for connection to a VAD. The absorbent material absorbs the disinfectant, and, upon connection to the hub of a VAD connector, compresses toward the syringe barrel while disinfecting the hub. The disinfectant can be a fluid, a foam, or a gel.

[0014] In a specific embodiment, the reservoir collar surrounds a connector collar adapted for connection to the hub of a VAD connector. In another specific embodiment, the connector collar is a luer connector.

[0015] A second aspect of the present invention pertains to a method of disinfecting a VAD connector. The method according to one embodiment comprises connecting a flush syringe assembly to the hub of a VAD connector, wherein the flush syringe assembly includes a plunger rod, a syringe barrel, and a reservoir collar that permits disinfection of the hub of a VAD connector upon connection to the device. The method allows the clinician to substantially achieve the effects of aseptic techniques without the need for added swabbing steps and diligence on the part of the clinician.

[0016] In a specific embodiment, the method comprises connecting a flush syringe assembly to a hub of the vascular access device, wherein connecting includes frictionally engaging a reservoir having a collar and a tip on the flush syringe with the hub vascular access device such that the hub contacts an antimicrobial agent contained within the reservoir. As noted above, the reservoir can contain an absorbent material, and the reservoir can include a first tip and a second tip, and the flush syringe includes a seal covering the reservoir and the first and second tip. In such construction, upon connecting the flush syringe assembly to the hub, the seal is broken to expose the second tip to the antimicrobial agent. The reservoir further can comprises threads that engage threads on the hub, and connecting occurs by engaging the threads on the hub and the reservoir by twisting the vascular access device with respect to the flush syringe. Upon connection, the hub contacts the antimicrobial agent and the absorbent material.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0017] FIGURE 1 is a perspective view of a flush syringe assembly according to an embodiment of the present invention;

[0018] FIGURE 2 is an enlarged partially cross-sectioned side elevation view of the assembled reservoir collar attached to flush syringe assembly of FIG. 1;

[0019] FIGURE 3 is an enlarged partially cross-sectioned side elevation view of the components of the reservoir collar which attaches to the flush syringe assembly of FIG. 1;

[0020] FIGURE 4 is an enlarged partially cross-sectioned side elevation view of the assembled reservoir collar for attachment to flush syringe assembly of FIG.1;

[0021] FIGURE 5 is an enlarged partially cross-sectioned side elevation view of the assembled reservoir collar being attached to the flush syringe assembly of FIG. 1;

[0022] FIGURE 6 is an enlarged partially cross-sectioned side elevation view of the reservoir collar attached to the flush syringe assembly of FIG.1, illustrating how the first tip of the syringe barrel attaches interlocks with the second tip of the reservoir collar;

[0023] FIGURE 7 is an enlarged partially cross-sectioned side elevation view of the reservoir collar illustrating removal of the seal over the end of the reservoir collar for attachment to a VAD;

[0024] FIGURE 8 is an enlarged partially cross-sectioned side elevation view of the reservoir collar illustrating attachment of the reservoir collar to the hub of a VAD connector;

[0025] FIGURE 9 is an enlarged partially cross-section side elevation view of the reservoir collar illustrating compression of the absorbent material upon connection to the hub of a VAD connector;

[0026] FIGURE 10 is an enlarged partially cross-sectioned side elevation view of an alternative embodiment of the reservoir collar; and

[0027] FIGURE 11 is an enlarged partially cross-sectioned side elevation view of the flush syringe assembly, illustrating an alternative embodiment of the reservoir collar for connection to the syringe assembly of FIG. 1.

## DETAILED DESCRIPTION

[0028] Before describing several exemplary embodiments of the invention, it is to be understood that the invention is not limited to the details of construction or process steps set

forth in the following description. The invention is capable of other embodiments and of being practiced or being carried out in various ways.

[0029] With respect to terms used in this disclosure, the following definitions are provided.

5 [0030] Reference to “flush syringe assembly” includes syringes that are indicated for use in the flushing of VADs. The practice of flushing ensures and maintains catheter patency and helps prevent the mixing of incompatible pharmaceuticals.

[0031] As used herein, the use of “a,” “an,” and “the” includes the singular and plural.

[0032] As used herein, the term “catheter related bloodstream infection” or “CRBSI”  
10 refers to any infection that results from the presence of a catheter or IV line.

[0033] As used herein, the term “microorganism” refers to a microbe or organism that is unicellular or lives in a colony of cellular organisms. Microorganisms are very diverse; they include, but are not limited to bacteria, fungi, archaea, and protozoans. Microorganisms are often the cause of CRBSIs. The most common microorganisms associated with CRBSIs  
15 include, but are not limited to, *Staphylococcus aureus* and *epidermis*, *Enterococcus faecalis*, *Escherichia coli*, *Pseudomonas aeruginosa*, and *Candida albicans*.

[0034] As used herein, the terms “antimicrobial agent” or “antimicrobial” refers to substances that kill or inhibit the growth of microorganisms such as bacteria, fungi, archaea, or protozoans. Antimicrobial agents either kill microbes, or prevent the growth of microbes.

20 [0035] As used herein, the term “disinfectant” refers to antimicrobial substances that are used on non-living objects or outside the body, e.g., on the skin.

[0036] In one or more embodiments, disinfectants or antimicrobial agent include, but are not limited to, ethanol, 2-propanol, butanol, methylparaben, ethylparaben, propylparaben, propyl gallate, butylated hydroxyanisole (BHA), butylated hydroxytoluene, t-butyl-  
25 hydroquinone, chloroxylonol, chlorohexidine, dichlorobenzyl alcohol, dehydroacetic acid, hexetidine, triclosan, hydrogen peroxide, colloidal silver, and mixtures thereof.

[0037] As used herein, the term “absorbent material” refers to a material having capacity or tendency to absorb or soak up another substance. In one or more embodiments, the absorbent material has a tendency to absorb a disinfectant or antimicrobial. Absorbent  
30 materials may include sponges, absorbent cottons, other absorbent fabrics, and synthetic polymer matrices.

[0038] As used herein, the term “Luer connector” refers to a connection collar that is the standard way of attaching syringes, catheters, hubbed needles, IV tubes, etc. to each other. The Luer connector consists of male and female interlocking tubes, slightly tapered to hold together better with even just a simple pressure/twist fit. Luer connectors can optionally include an additional outer rim of threading, allowing them to be more secure. The Luer connector male end is generally associated with a flush syringe and can interlock and connect to the female end located on the VAD. A Luer connector comprises a distal end, a proximal end, an irregularly shaped outer wall, a profiled center passageway for fluid communication from the chamber of the barrel of a syringe to the hub of a VAD. A Luer connector also has a distal end channel that releasably attaches the Luer connector to the hub of a VAD, and a proximal end channel that releasably attaches the Luer connector to the barrel of a syringe.

[0039] Provided are syringe assemblies that include a plunger rod and a syringe barrel, that incorporate an element for disinfecting the hub of a VAD. The assembled syringe assembly is shown in Figures 1 and 2, with the components shown separately in Figures 3-9. Alternative embodiments of the present invention are shown in Figures 10-11. Referring to Figures 1-3, a syringe assembly **20** according to the present invention generally comprises a barrel **21**, including a side wall having an inside surface defining a chamber for retaining fluid. The barrel **21** further includes an open proximal end **27** and a distal end **28** having a distal wall **29** with an elongated first tip **31** extending distally therefrom and having a first passageway **32** therethrough in fluid communication with the chamber, the tip adapted for connection to a reservoir collar **40**. The distal wall **29** may comprise a plurality of threads for attachment to the reservoir collar **40**.

[0040] An plunger rod **37** includes distal portion **38** and a proximal portion **39**, the plunger rod further comprising a distal end including a stopper slidably positioned in fluid-tight engagement with the inside surface of the barrel for drawing fluid into and driving fluid out of the chamber by movement of the stopper relative to the barrel, the plunger rod **37** extending outwardly from the open proximal end **27** of the barrel, the stopper having a distal surface.

[0041] A reservoir collar **40** mounted on the distal end **28** of the barrel and surrounding the first tip **31**, the reservoir collar **40** including at least one side wall **41** having an inside surface **42** defining a compartment **43** containing a disinfectant or antimicrobial agent, a sealed distal end **45**, and a proximal end **46** adjacent the distal wall **29** of the barrel, with a

second tip **51** extending distally therefrom having a second passageway **52** therethrough in fluid communication with said first passageway **32**, the second tip **51** adapted for connection to a hub of a vascular access device. The reservoir collar **40** may comprise a plurality of threads **47** on the inside surface for connection to a vascular access device. The reservoir collar **40** may comprise a plurality of threads on the proximal end for attachment to the distal wall **29** of the barrel. Referring to Figure 5, upon manufacture, the flush syringe assembly **20** can be provided with the reservoir collar **40** partially threaded at the proximal end **46** onto the distal wall **29** of the barrel. The seal **49**, is not yet pierced. Referring to Figure 6, to activate the reservoir collar **40**, the clinician can twist the proximal end **46** onto the distal wall **29** such that the threads tightly interlock and the first tip **31** pierces the seal **49**. The first tip **31** then becomes interlocked with the second tip **51**, and the first passageway **32** and the second passageway **52** become one integral passageway for fluid communication from the barrel **21** to a VAD.

[0042] The reservoir collar **40** may comprise an absorbent material **44** surrounding the second tip **51** for soaking up the disinfectant or antimicrobial agent that is housed within the compartment **43**. The disinfectant or antimicrobial agent can be a fluid or a gel selected from the group consisting of selected from the group consisting of ethanol, 2-propanol, butanol, methylparaben, ethylparaben, propylparaben, propyl gallate, butylated hydroxyanisole (BHA), butylated hydroxytoluene, t-butyl-hydroquinone, chloroxylonol, chlorohexidine, dichlorobenzyl alcohol, dehydroacetic acid, hexetidine, triclosan, hydrogen peroxide, colloidal silver, and mixtures thereof.

[0043] The sealed distal end **45** of the reservoir collar **40** may comprise a removable seal **48**. The removable seal **48** can comprise an aluminum peel back top. The seal can be a plastic sealed aluminum, and can be chemically-resistant, light-blocking, non-permeable, or sterile.

[0044] The reservoir collar **40** may comprise an aluminum lining adhered to the inside surface **42** of at least one side wall **41**. The aluminum lining can prevent degradation of the disinfectant or antimicrobial agent, and can also provide a mechanism for ensuring compliance with aseptic conditions.

[0045] The reservoir collar **40** may be removable from the syringe assembly **20**. When removable, the reservoir collar **40** comprises a pierceable seal **49** on the proximal end **46** of the reservoir collar **40**. The pierceable seal **49** can be pierced by the first tip **31** upon

connection to the distal wall **29** of the barrel. The pierceable seal **49** can comprise an aluminum seal. The aluminum seal can be a plastic sealed aluminum, and can be chemically-resistant, light-blocking, non-permeable, or sterile.

**[0046]** In an embodiment, the reservoir collar **40** surrounds a connector collar adapted for connection to the hub of the vascular access device. The connector collar can further comprise an absorbent material **44** for soaking up the disinfectant or antimicrobial agent dispersed within the connector collar. The disinfectant or antimicrobial agent can be a fluid or a gel. In a further embodiment, the reservoir collar **40** surrounds a connector collar adapted for connection to the hub of the vascular access devices, wherein the connector collar is a Luer connector.

**[0047]** Referring to Figures 4-6, in operation, the assembled, removable reservoir collar **40** is attached via the proximal end **46** to the distal wall **29** of the syringe barrel **21** such that the proximal end **46** of the reservoir collar **40** is adjacent to the distal wall **29** of the syringe barrel **21**. The first tip **31** interlocks with the second tip **51** such that the first passageway **32** and the second passageway **52** become one integral passageway for fluid communication to a vascular access device. Referring to Figure 5, upon manufacture, the flush syringe assembly **20** can be provided with the reservoir collar **40** partially threaded at the proximal end **46** onto the distal wall **29** of the barrel **21**. The seal **49** is not yet pierced. Referring to Figure 6, to activate the reservoir collar **40**, the clinician can twist the proximal end **46** onto the distal wall **29** such that the threads tightly interlock and the first tip **31** pierces the seal **49**. The first tip **31** then becomes interlocked with the second tip **51**, and the first passageway **32** and the second passageway **52** become one integral passageway for fluid communication from the barrel **21** to a VAD. Once the reservoir collar **40** has been activated by threading it onto the distal wall **29**, it is now ready to be used to disinfect the hub of a VAD.

**[0048]** The syringe assembly **20** is filled with flush solution using known methods. Additionally, the syringe assembly **20** may be provided pre-filled from the manufacturer or supplier. The flush solution may be any solution intended for flushing or maintaining performance of VAD's. It is preferred that the flush solution be selected from the group consisting of saline flush solution and heparin lock flush solution. These solutions are known in the art and are readily available. An example of a saline flush solution includes, but is not limited to, 0.9% sodium chloride USP for injection. An example of a heparin lock flush solution includes but is not limited to 0.9% sodium chloride with 100 USP units of heparin

sodium per mL or 10 USP units of heparin sodium per mL. When the first tip **31** interlocks with the second tip **51**, the flush solution is communicated from the barrel **21** through the now integral first passageway **32** and second passageway **52** to a vascular access device.

[0049] The syringe assembly **20** is now ready for use in flushing a vascular access device such as a catheter or IV set. IV sets can be very complex and may include multiple injection ports, valves, and/or other components. For the purpose of illustrating the present invention, a simplified IV set or catheter hub **60** is illustrated in Figures 8 and 9. The hub **60** includes a housing hollow interior and a septum **61** at its proximal end **62**. A hollow IV line or catheter **64** extends from the distal end **63** from the housing. The IV site may be a valve having structure for accepting the second tip **51** and being activated by the insertion of the second tip **51** to establish fluid communication with the IV line or catheter **64**.

[0050] There are two general classifications of VAD's, peripheral catheters and central venous catheters. Peripheral catheters are used to access veins in the peripheral extremities such as the hand and ann. Peripheral catheters are relatively short in length ranging from about 14 mm to 48 mm in length, and are available in gauge sizes from about 16 to 24. It is believed that the most commonly used peripheral catheters are 20 gauge having an ID of about 0.81 mm (0.032 inch) and 22 gauge having an ID of about 0.66 mm (0.026 inch), and having a length of about 25mm to 32mm. As used herein, the term "peripheral catheter" is intended to refer to a 20 or 22 gauge catheter having a length of about 25mm. Central venous catheters are substantially longer than peripheral catheters and are inserted in the patient and terminate near the heart.

[0051] Referring to Figures 7-9, the syringe assembly **20** when connected with reservoir collar **40** has a second tip **51** that is rendered antimicrobial because it is surrounded by an absorbent material **44** that soaks up disinfectant or antimicrobial agent contained within compartment **43**. The now antimicrobial tip **51** can be connected to a vascular access device. The seal **48** is removed from the distal end **45** of the reservoir collar **40**, exposing the second tip **51**. As the syringe assembly **20** is connected to the hub of a vascular access device **60**, the absorbent material **44** compresses creating friction. The disinfecting properties of the disinfectant or antimicrobial agent contained within the chamber **43** that has been absorbed by absorbent material **44**, disinfect the hub **60**, thus ensuring compliance with aseptic technique. The friction created by the compression of the absorbent material **44** is necessary to provide disinfection of the hub **60**. Once the connection of the syringe assembly **20** to the hub **60** is

completed, the hub is properly disinfected, and fluid communication from the barrel **21** of the syringe to the vascular access device can occur. Fluid is drawn from the barrel **21** through the integral first passageway **32** and second passageway **52** through the hub **60** and into the IV or catheter **64**. Because of the presence of the reservoir collar **40**, fluid communication through a vascular access device and into a patient is conducted under aseptic conditions without any additional swabbing steps and diligence on the part of the clinician.

**[0052]** Figure 10 illustrates an alternative embodiment of the reservoir collar **40**. Additional space **70** between the plurality of threads **47** and the proximal end **46**, allows the clinician to fully rotate the syringe assembly **20** and completely disinfect the hub **60** of a vascular access device upon connection of the syringe assembly **20** to the hub **60**.

**[0053]** Figure 11 illustrates another embodiment of the syringe assembly **20**. The reservoir collar **40** can be integrally formed on the distal wall **29** of the syringe barrel **21** with a second tip **51** with a second passageway **52** extending therethrough for fluid communication to the vascular access device. A seal **48** will contain the disinfectant or antimicrobial agent within the chamber **43** until the seal **48** is removed and the syringe assembly **20** is connected to a vascular access device. The absorbent material **44** will soak up the disinfectant or antimicrobial agent and will disinfect the hub of a vascular access device upon connection. This alternative syringe assembly is simpler to manufacture compared to the assembly of FIGs. 1-3. However, extractables may increase.

**[0054]** Although the invention herein has been described with reference to particular embodiments, it is to be understood that these embodiments are merely illustrative of the principles and applications of the present invention. It is therefore to be understood that numerous modifications may be made to the illustrative embodiments and that other arrangements may be devised without departing from the spirit and scope of the present invention as disclosed.

## WHAT IS CLAIMED IS:

1. A flush syringe assembly comprising:

a barrel including a side wall having an inside surface defining a chamber for retaining fluid, an open proximal end, a distal end including a distal wall with a first tip extending distally therefrom having a first passageway therethrough in fluid communication with said chamber, the first tip adapted for connection to a reservoir collar;

a plunger rod disposed within the barrel, the plunger rod comprising a distal portion and a proximal portion, the plunger rod further comprising a distal end including a stopper slidably positioned in fluid-tight engagement with the inside surface of the barrel for drawing fluid into and driving fluid out of the chamber by movement of the stopper relative to the barrel, the plunger rod extending outwardly from the open proximal end of the barrel, the stopper having a distal surface; and

the reservoir collar mounted on the distal wall of the barrel and surrounding the first tip, the reservoir collar including at least one side wall having an inside surface defining a compartment containing a disinfectant or antimicrobial agent, a sealed distal end, a proximal end adjacent the distal wall of the barrel, with a second tip extending distally therefrom having a second passageway therethrough in fluid communication with said first passageway, the second tip adapted for connection to a hub of a vascular access device.

2. The flush syringe assembly of claim 1, wherein the reservoir collar has a plurality of threads on the inside surface for connection to the hub of the vascular access device.

3. The flush syringe assembly of any of claims 1-2, wherein the distal wall of the barrel and the proximal end of the reservoir collar both contain a plurality of threads to connect the reservoir collar to the barrel.

4. The flush syringe assembly of claim 3, wherein the proximal end of the reservoir collar is threaded onto the distal wall of the barrel.

5. The flush syringe assembly of any of claims 1-2, wherein the reservoir collar further comprises an absorbent material for soaking up the disinfectant or antimicrobial agent.

6. The flush syringe assembly of any of the preceding claims, wherein the reservoir collar surrounds a connector collar adapted for connection to the hub of the vascular access device.

7. The flush syringe assembly of any of the preceding claims, wherein the disinfectant or antimicrobial agent is a fluid or gel.

8. The flush syringe assembly of any of the preceding claims, wherein the disinfectant or antimicrobial agent is selected from the group consisting of ethanol, 2-propanol, butanol, methylparaben, ethylparaben, propylparaben, propyl gallate, butylated hydroxyanisole (BHA), butylated hydroxytoluene, t-butyl-hydroquinone, chloroxylenol, chlorohexidine, dichlorobenzyl alcohol, dehydroacetic acid, hexetidine, triclosan, hydrogen peroxide, colloidal silver, and mixtures thereof.

9. The flush syringe assembly of claim 6, further comprising an absorbent material, for soaking up the disinfectant or antimicrobial agent, dispersed within the connector collar.

10. The flush syringe assembly of claim 9, wherein the disinfectant or antimicrobial agent is a fluid, foam, or gel.

11. The flush syringe assembly of any of the preceding claims, further comprising a seal adhered to the distal end of the reservoir collar.

12. The flush syringe assembly of claim 11, wherein the seal comprises an aluminum or multi-layer polymer film peel back top.

13. The flush syringe assembly of any of the preceding claims, further comprising an aluminum lining adhered to the inside surface of the at least one side wall of the reservoir collar.

14. The flush syringe assembly of claim 5, wherein the absorbent material compresses toward the proximal end of the reservoir collar upon connection to the hub of the vascular access device.

15. The flush syringe assembly of claim 14, wherein the compression of the absorbent material disinfects the vascular access device.

5 16. The flush syringe assembly of claim 9, wherein the absorbent material compresses upon connection to the hub of the vascular access device.

17. The flush syringe assembly of claim 16, wherein the compression of the absorbent material disinfects the vascular access device.

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18. The flush syringe assembly of any of the preceding claims, wherein connection to the hub of the vascular access device disinfects the vascular access device.

15 19. The flush syringe assembly of claim 6, wherein the connection collar is a Luer connector.

20. The flush syringe assembly of any of the preceding claims, wherein the reservoir collar is removable.

20 21. The flush syringe assembly of claim 20, further comprising a seal adhered to the proximal end of the reservoir collar that is pierced by the first tip of the barrel upon connection of the reservoir collar to the distal wall of the barrel.

22. The flush syringe assembly of claim 21, wherein the seal is a pierceable aluminum.

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23. A method of disinfecting a vascular access device, the method comprising:  
connecting a flush syringe assembly to a hub of the vascular access device,  
wherein connecting includes frictionally engaging a reservoir collar having a tip on the  
flush syringe with the hub of the vascular access device such that the hub contacts an  
antimicrobial agent or disinfectant contained within the reservoir collar.

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24. The method of claim 23, wherein the reservoir collar further contains an absorbent material.

5 25. The method of claim 23 or 24, wherein the reservoir collar includes a first tip and a second tip and the flush syringe includes a seal covering the reservoir collar and the first and second tip.

26. The method of claim 25, wherein upon connecting the flush syringe assembly to the hub, the seal is removed to expose the second tip to the antimicrobial agent or disinfectant.

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27. The method of claim 26, wherein the reservoir collar further comprises threads that engage threads on the hub, and connecting occurs by engaging the threads on the hub and the reservoir collar by twisting the vascular access device with respect to the flush syringe.

15 28. The method of claim 26, wherein upon connection, the hub contacts the antimicrobial agent or disinfectant and the absorbent material.