infection risk when compared to previous needled systems (Danzig et al., JAMA 273:1862-1864 (1995); Kellerman et al., J. Pediatr. 129:711-717 (1996)). These systems differ from older needle-containing systems by nature of their hub design.

Therefore, prevention of hub colonization will reduce or prevent the introduction of microorganisms into the catheter lumen. Such prevention may be evoked through careful cleaning and preparation of the catheter prior to use. Often however, such care is less than optimal and, in an emergency situation especially, catheter hubs are not often cleaned appropriately (Stotter et al., JPEN 11:159-162 (1987); Sitges-Serra, Support Care Cancer 7:391-395 (1999)). Neither the currently used Luer-lock connector or the rubber membrane "piggyback" system have anti-microbial properties and therefore require strict aseptic manipulation. In addition, proper hub care requires additional training and increases the time required for already constrained health care professionals.

Thus, there exists a need for techniques and devices that can be effective at reducing microbial contamination of a catheter connection. The present invention satisfies this need and provides related advantages as well.

## SUMMARY OF INVENTION

According to a first aspect of the invention, there is provided a cleaning injection port cap, comprising: a substantially cylindrical body comprising a passageway extending from a proximate end to a distal end, the proximate end being configured to open for receiving an end portion of a tube to be capped and to close for holding the end portion; an actuating member disposed on a middle portion of the body and configured to open only the proximate end of the body by squeezing the actuating member and to close the proximate end of the body by releasing the squeezed actuating member; a plurality of separable absorbent elements located within the passageway adjacent the proximal end; and a flexible fluid impermeable sheath covering and layered on at least a portion of an exterior of the body.

According to a second aspect of the invention, there is provided a cleaning device, comprising: a substantially cylindrical body having a cavity and a squeezing position disposed on a middle of the cylindrical body and configured to open only one end of the cleaning device from a closed state when compressed and to close said one end when released; and a scrubbing foam disposed in said cavity, the scrubbing foam comprising substantially half cylindrical shaped foams; wherein each of said half cylindrical shaped foams has a semicircle fluid impermeable member which prevents a solution from

evaporating from said scrubbing foam and faces outward from said cavity when the cleaning device is in the closed state.

An embodiment of ~~T~~the invention provides an injection port cap, comprising a body having a cavity extending from a distal end to a proximate end of the body; a movable frit located within the cavity so as to form a reservoir between the frit and the proximate end of the body; a biasing element arranged to urge the movable frit towards the distal end of the body; and an absorbent element located within the cavity adjacent the distal end of the body.

A further embodiment of ~~T~~the invention ~~also~~ provides a catheter cleaning device comprising a body comprising a passageway extending from a proximate opening adjacent a proximate end to a distal end; a penetrable sealing element located adjacent the proximate end within the passageway; an absorbent element located within the passageway between the distal end and the penetrable sealing element; at least one brush located between the penetrable sealing element and the absorbent element; a luer connector located within the passageway between the distal end and the brushes; and a reservoir formed within the passageway between the luer connector and the penetrable sealing element.

A further embodiment of ~~T~~the invention ~~additionally~~ provides a catheter cleaning injection port cap, comprising a body comprising a passageway extending from a proximate end to a distal end; the proximate

What is claimed is:

1. An injection port cap, comprising:

a body having a cavity extending from a distal end to a proximate end of the body;

a movable frit located within said cavity so as to form a reservoir between the frit and the proximate end of the body;

a biasing element arranged to urge the movable frit towards the distal end of the body; and

an absorbent element located within the cavity adjacent the distal end of the body.

2. The injection port cap of claim 1, wherein the frit is comprised of a porous material.

3. The injection port cap of claim 1, wherein the biasing element comprises a spring.

4. The injection port cap of claim 1, wherein the biasing element comprises a helical spring.

5. The injection port cap of claim 1, wherein the biasing element comprises a helical spring located within the reservoir.

6. The injection port cap of claim 1, wherein the absorbent element comprises a sponge.

7. The injection port cap of claim 1, wherein the frit is configured to provide a fluid pathway between the reservoir and the absorbent element.

8. The injection port cap of claim 7, wherein a liquid in the reservoir is forced through the frit to the absorbent element when the frit is moved against the biasing element towards the proximate end of the body.

9. The injection port cap of claim 1, wherein the cavity has a substantially cylindrical shape.

10. The injection port cap of claim 9, wherein the absorbent element is located along at least a portion of a circumference of the cavity adjacent the distal end of the body.

~~11. The injection port cap of claim 1, wherein the body further comprises a window~~ positioned to indicate a position of the frit.

12. The injection port cap of claim 1, wherein the cavity comprises a closed end at the proximate end of the body and an opening at the distal end of the body.

13. The injection port cap of claim 12, wherein said reservoir is located between a top surface of the frit and the closed end of the cavity.

14. The injection port cap of claim 12, wherein the opening of the cavity is sized to accommodate a catheter.

15. The injection port cap of claim 12, wherein the opening of the cavity further comprising screw threads adjacent the distal end of the body.

16. The injection port cap of claim 15, wherein the screw thread are configured to accommodate a luer fitting of a needleless injection port.

17. The injection port cap of claim 1, wherein the cap further comprises a sealing member located between a side surface of the frit and an inner surface of the cavity.

18. The injection port cap of claim 17, wherein the sealing member comprises an elastomer o-ring located around the side surface of the frit.

19. The injection port cap of claim 1, further comprising an antimicrobial solution located within the reservoir.

20. A catheter cleaning device comprising:

a body comprising a passageway extending from a proximate opening adjacent a proximate end to a distal end;

a penetrable sealing element located adjacent the proximate end within the passageway;

an absorbent element located within the passageway between the distal end and the penetrable sealing element;

at least one brush located between the penetrable sealing element and the ~~absorbent element;~~

~~a luer connector located within the passageway between the distal end and the~~ brushes; and

a reservoir formed within the passageway between the luer connector and the penetrable sealing element.

21. The catheter cleaning device of claim 20, wherein the luer connector is a female luer connector.

22. The catheter cleaning device of claim 20, wherein the penetrable sealing element comprises absorbent foam.

23. The catheter cleaning device of claim 20, wherein the penetrable sealing device is configured to operate in a first position when a luer fitting is inserted within the proximate opening and in a second position when no luer fitting is inserted within the proximate opening.

24. The catheter cleaning device of claim 23, wherein the penetrable sealing element compresses radially when operating in the first position.

24 The catheter cleaning device of claim 23, wherein the penetrable sealing device is configured to reduce evaporation of a fluid within the passageway operating in the second position.

25. The catheter cleaning device of claim 20, wherein the absorbent element includes a central opening having a major axis substantially in-line with a major axis of the passageway.

26. The catheter cleaning device of claim 25, wherein an inner surface of the absorbent element along its central opening is configured to contact a luer fitting positioned adjacent the luer connector.

27. The catheter cleaning device of claim 20, wherein a bottom portion of the absorbent element is located adjacent a top portion of the luer connector.

28. The catheter cleaning device of claim 20, wherein the absorbent element is at least ~~partially impregnated with antimicrobial solution.~~

~~29. The catheter cleaning device of claim 28, wherein the absorbent element is~~ configured to radially compress when a luer fitting is attached to the luer connector such that a portion of the antimicrobial solution travels from the absorbent element to the reservoir.

30. The catheter cleaning device of claim 29, wherein the portion of the antimicrobial solution in the reservoir is located adjacent to an interface between the luer fitting and the luer connector.

31. The catheter cleaning device of claim 20, further comprising a piston located within the passageway and extending from the luer connector through the distal end of the body.

32. The catheter cleaning device of claim 20, wherein the penetrable sealing element comprises foam

33. The catheter cleaning device of claim 20, wherein the absorbent element comprises open cell foam.

34. A catheter cleaning injection port cap, comprising:

a body comprising a passageway extending from a proximate end to a distal end;

the proximate end operable in a closed position and an open position;

the body further comprising an actuating member configured to change the proximate end from the closed position to the open position;

a plurality of separable absorbent elements located within the passageway adjacent the proximal end; and

a fluid impermeable sheath covering at least a portion of an exterior of the body.

35. The catheter cleaning injection port cap of claim 34, wherein the absorbent elements are impregnated with an antimicrobial solution.

36. The catheter cleaning injection port cap of claim 34, wherein the absorbent elements form a substantially closed surface when the proximate end is operated in the closed position.

~~37. The catheter cleaning injection port cap of claim 34, wherein the absorbent elements~~ are spatially separated from one another when the proximate end is operated in the open position.

38. The catheter cleaning injection port cap of claim 34, wherein the proximate end is configured to accommodate a luer fitting when operated in the open position.

39. The catheter cleaning injection port cap of claim 34, wherein one or more of the absorbent elements are configured to contact an exterior of a luer fitting being inserted in the proximate end.

40. The catheter cleaning injection port cap of claim 34, wherein the plurality of separable absorbent elements include two substantially half cylindrical sponges, wherein the sponges are adjacent one another when the proximate end is operated in the closed position and separate from one another when the proximate end is operated in the open position.

41. The catheter cleaning injection port cap of claim 34, wherein the body is constructed of a deformable material.

42. The catheter cleaning injection port cap of claim 34, wherein the actuating member comprises at least one compressible portion protruding radially outward from a major axis of the passageway.

43. The catheter cleaning injection port cap of claim 42, wherein when the at least one compressible portion is compressed, the proximate end is in the open position; and when the at least one compressible portion is uncompressed, the proximate end is in the closed position.

44. The catheter cleaning injection port cap of claim 34, wherein the distal end is bonded to a needleless valve.

45. The catheter cleaning injection port cap of claim 44, wherein a bottom surface of the absorbent element adjacent an opening of the needleless valve when the distal end is ~~bonded to the needleless valve.~~

~~46. A method of adapting a luer activated needleless valve, comprising the step of~~ bonding a catheter cleaning injection port cap over an opening of the luer activated needleless valve.

47. The method of claim 46 wherein the catheter cleaning injection cap comprises:

a body comprising a passageway extending from a proximate end to a distal end;

the proximate end operable in a closed position and an open position;

the body further comprising an actuating member configured to change the proximate end from the closed position to the open position;

a plurality of separable absorbent elements located within the passageway adjacent the proximal end; and

a fluid impermeable sheath covering at least a portion of an exterior of the body.

48. A catheter cleaning device, comprising a body having a cavity; a movable frit disposed in said cavity, whereby said frit is positioned to form a reservoir in said cavity; a spring disposed in said reservoir; an o-ring disposed between said frit and the wall of said cavity; and a scrubbing foam disposed in said cavity proximal to said frit and distal to said reservoir.

49. The catheter cleaning device of claim 48, further comprising a window positioned to indicate the position of said frit in said cavity.

50. The catheter cleaning device of claim 48, further comprising an antimicrobial solution dispersed in said reservoir.

51. A catheter cleaning device, comprising a body having a cavity; a plug disposed in said cavity; a piston positioned proximal to said plug in said cavity; a scrubbing foam proximal to said piston; brushes proximal to said scrubbing foam; a seal proximal to said brushes; and a reservoir in said cavity adjacent to said scrubbing foam, whereby insertion of a male luer allows penetration through said scrubbing foam, brushes and seal and displacement of fluid into said reservoir.

52. The catheter cleaning device of claim 51, further comprising an antimicrobial ~~solution dispersed in said scrubbing foam and brushes.~~

~~53. A catheter cleaning device, comprising a body having a cavity and a compressible~~ position; a scrubbing foam disposed in said cavity; wherein said scrubbing foam has a fluid impermeable side that faces outward from said cavity, and a needleless port disposed in said cavity.

54. The catheter cleaning device of claim ~~53~~, further comprising an antimicrobial solution dispersed in said scrubbing foam.

55. A catheter cleaning device, comprising a body having a cavity, said body having a closed end and an open end; a scrubbing foam disposed in said cavity, and an ~~antimicrobial solution dispersed through said scrubbing foam.~~

What is claimed is:

1. A cleaning injection port cap, comprising: a substantially cylindrical body comprising a passageway extending from a proximate end to a distal end, the proximate end being configured to open for receiving an end portion of a tube to be capped and to close for holding the end portion; an actuating member disposed on a middle portion of the body and configured to open only the proximate end of the body by squeezing the actuating member and to close the proximate end of the body by releasing the squeezed actuating member; a plurality of separable absorbent elements located within the passageway adjacent the proximal end; and a flexible fluid impermeable sheath covering and layered on at least a portion of an exterior of the body.

2. The cleaning injection port cap of claim 1, wherein the absorbent elements are impregnated with an antimicrobial solution.

3. The cleaning injection port cap of claim 1, wherein the absorbent elements form a substantially closed surface when the proximate end is closed.

4. The cleaning injection port cap of claim 1, wherein the absorbent elements are spatially separated from one another when the proximate end is opened.

5. The cleaning injection port cap of claim 1, wherein the proximate end is configured to accommodate a luer fitting disposed at the end portion of the tube when the proximate end is opened.

6. The cleaning injection port cap of claim 1, wherein one or more of the absorbent elements are configured to scrub an exterior of the end portion of the tube as the end portion of the tube is inserted in the proximate end.

7. The cleaning injection port cap of claim 1, wherein the plurality of separable absorbent elements include two substantially half cylindrical sponges, wherein the sponges are adjacent one another when the proximate end is closed and separate from one another when the proximate end is opened.

8. The cleaning injection port cap of claim 1, wherein the body is constructed of a deformable material.

9. The cleaning injection port cap of claim 1, wherein the actuating member comprises at least one squeezing portion protruding radially outward from a major axis of the passageway.

10. The cleaning injection port cap of claim 9, wherein: said at least one squeezing portion has a concave portion for fingers to squeeze the actuating member.

11. The cleaning injection port cap of claim 1, wherein the cleaning injection cap further comprises a needleless valve connector for a needleless valve to be attached to the distal end.

12. The cleaning injection port cap of claim 11, wherein a bottom surface of the absorbent element is configured to contact an opening of the needleless valve.

13. The cleaning injection port cap of claim 11, wherein the needleless valve have a luer fitting connector configured to accommodate a luer fitting disposed at the end portion of the tube.

14. The cleaning injection port cap of claim 1, further comprising a luer fitting element, wherein: the luer fitting element has a first end and a second end, the first end is disposed in the body of the cleaning injection port cap and is configured to accommodate the end portion of the tube, and the second end is disposed outside the body of the cleaning injection port cap and is configured to accommodate an end portion of a catheter.

15. The cleaning injection port cap of claim 14, wherein the first end of the luer fitting element has a female screw and the second end of the luer fitting element has a male screw.

16. A cleaning device, comprising: a substantially cylindrical body having a cavity and a squeezing position disposed on a middle of the cylindrical body and configured to open only one end of the cleaning device from a closed state when compressed and to close said one end when released; and a scrubbing foam disposed in said cavity, the scrubbing foam comprising substantially half cylindrical shaped foams; wherein each of said half cylindrical shaped foams has a semicircle fluid impermeable member which prevents a solution from evaporating from said scrubbing foam and faces outward from said cavity when the cleaning device is in the closed state.

17. The cleaning device of claim 16, further comprising an antimicrobial solution dispersed in said scrubbing foam.

18. The cleaning device of claim 16, wherein the scrubbing foam is configured to scrub an exterior of an end portion of a tube as the end portion of the tube is inserted in the cleaning device.

19. The cleaning device of claim 16, further comprising a luer fitting element, wherein: the luer fitting element has a first end and a second end, the first end is disposed in the body of the cleaning device

and is configured to accommodate an end portion of a tube, and the second end is disposed outside the body of the cleaning device and is configured to accommodate an end portion of a catheter.

20. The cleaning device of claim 19, wherein the first end of the luer fitting element has a female screw and the second end of the luer fitting element has a male screw.

21. The cleaning device of claim 16, wherein an end portion of the cylindrical body covers a circumference area of the semicircle fluid impermeable member.