CLAIMS

We claim:

1. A catheter system, comprising:

a catheter assembly, comprising:

a catheter adapter, comprising a distal end, a proximal end, and a lumen extending through the distal end of the catheter adapter and the proximal end of the catheter adapter; and

a catheter secured within the catheter adapter and extending distally from the distal end of catheter adapter; and

a needle assembly, comprising:

a needle hub, comprising:

a distal end coupled to the proximal end of the catheter adapter;

a proximal end;

a flashback chamber extending through the proximal end of the needle hub; and

a through-hole disposed at a distal end of the flashback chamber; and

an introducer needle press-fit within the through-hole.

2. The catheter system of claim 1, further comprising a plug coupled to the proximal end of the needle hub, wherein the plug plugs a proximal opening of the flashback chamber and provides venting of the flashback chamber.

3. The catheter system of claim 2, wherein the plug comprises a distal end, a proximal end, a lumen extending through the distal end of the plug and the proximal end of the plug, and a tubular section disposed between the distal end of the plug and the proximal end of the plug, wherein the distal end of the plug comprises a neck portion extending from the tubular section and a skirt extending from the tubular

section to define an annular channel between the skirt and the neck portion, wherein the neck portion is inserted into the proximal end of the needle hub, wherein an outer surface of the neck portion comprises a plurality of air vent channels configured to provide venting of the flashback chamber, wherein the proximal end of the plug comprises a luer adapter and a septum disposed within the luer adapter.

4. The catheter system of claim 3, wherein the septum comprises a resiliently deformable piston element, wherein the piston element comprises a piston head coupled to a plurality of bellows, wherein the piston head comprises a slit or bore.

5. The catheter system of claim 2, wherein the plug comprises a distal end, a proximal end, a lumen extending through the distal end and the proximal end, and a tubular section disposed between the distal end and the proximal end, wherein the distal end of the plug comprises a neck portion extending from the tubular section and a skirt extending from the tubular section to define an annular channel between the skirt and the neck portion, wherein the neck portion is inserted into the proximal end of the needle hub, wherein the proximal end of the plug comprises a luer adapter and a septum disposed within the luer adapter, wherein a portion of a wall of the tubular section comprises a hole, a hydrophobic membrane disposed within the hole towards an outside of the plug, and a hydrophilic membrane within the hole towards an inside of the plug, wherein the hydrophilic membrane prevents fluid leakage through the hole, wherein the hydrophobic membrane provides venting of the flashback chamber.

6. The catheter system of claim 5, wherein the septum comprises a proximal portion disposed outside the luer adapter, a distal portion extending across the tubular

section, an intermediate portion between the proximal portion and the distal portion, and a slit extending longitudinally through the proximal portion, the distal portion, and the intermediate portion, wherein a cross-section of the proximal portion, the distal portion, and the intermediate portion forms a general H-shape, wherein the hole is distal to the distal portion of the septum.

7. The catheter system of claim 2, wherein the plug comprises a distal end, a proximal end, and tubular section disposed between the distal end and the proximal end, wherein the distal end of the plug comprises a neck portion extending from the tubular section and a skirt extending from the tubular section to define an annular channel between the skirt and the neck portion, wherein the neck portion is inserted into the proximal end of the needle hub, wherein the proximal end comprises a luer adapter and a septum disposed within the luer adapter, wherein a portion of a wall of the tubular section comprises a hole, wherein a porous membrane is disposed within the hole, wherein the porous membrane is configured to pass air but not blood.

8. The catheter system of claim 7, wherein the septum comprises a proximal portion disposed outside the luer adapter, a distal portion extending across the tubular section, an intermediate portion between the proximal portion and the distal portion, and a slit extending longitudinally through the proximal portion, the distal portion, and the intermediate portion, wherein a cross-section of the proximal portion, the distal portion, and the intermediate portion forms a general H-shape, wherein the hole is distal to the distal portion of the septum.

9. The catheter system of claim 1, wherein a distal end of the catheter comprises a notch, wherein the notch is in fluid communication with the flashback chamber.

10. The catheter system of claim 1, wherein the needle assembly further comprises a grip extending outwardly from the needle hub and distal to the distal end of the needle hub.

11. The catheter system of claim 1, wherein the introducer needle comprises a plurality of inner diameters.

~~12. A method of collecting blood, comprising:~~

~~inserting a catheter system into vasculature of a patient, wherein the catheter system comprises:~~

~~a catheter assembly, comprising:~~

~~a catheter adapter, comprising a distal end, a proximal end, and a lumen extending through the distal end of the catheter adapter and the proximal end of the catheter adapter; and~~

~~a catheter secured within the catheter adapter and extending distally from the distal end of catheter adapter;~~

~~a needle assembly, comprising:~~

~~a needle hub, comprising:~~

~~a distal end coupled to the proximal end of the catheter adapter;~~

~~a proximal end;~~

~~a flashback chamber extending through the proximal end of the needle hub; and~~

~~a through-hole disposed at a distal end of the flashback chamber;~~

~~and~~

~~an introducer needle press-fit within the through-hole; and~~

~~a plug coupled to the proximal end of the needle hub, wherein the plug plugs a proximal opening of the flashback chamber and provides venting of the flashback chamber, wherein the plug comprises distal end, a proximal end, a lumen extending through the distal end of the plug and the proximal end of the plug, and a tubular section disposed between the distal end of the plug and the proximal end of the plug, wherein the distal end comprises a neck portion extending from the tubular section and a skirt extending from the tubular section to define an annular channel between the skirt and the neck portion, wherein the neck portion is inserted into the proximal end of the needle hub, wherein the proximal end of the plug comprises a luer adapter and a septum disposed within the luer adapter;~~

~~coupling a blood collection device to the proximal end of the plug; and~~

~~collecting blood from the vasculature within the blood collection device.~~

~~13. The method of claim 12, further comprising priming the catheter system prior to insertion of the catheter system into the vasculature.~~

~~14. The method of claim 13, wherein a distal end of the catheter comprises a notch, wherein the notch is in fluid communication with the flashback chamber, wherein the blood from the vasculature is collected within the blood collection device without a discard blood sample.~~

~~15. The method of claim 12, wherein the septum comprises a resiliently deformable piston element, wherein the piston element comprises a piston head coupled to a plurality of bellows, wherein the piston head comprises a slit or bore.~~

~~16. The method of claim 12, wherein the plug comprises a distal end, a proximal end, a lumen extending through the distal end and the proximal end, and a tubular section disposed between the distal end and the proximal end, wherein the distal end comprises a neck portion extending from the tubular section and a skirt extending from the tubular section to define an annular channel between the skirt and the neck portion, wherein the neck portion is inserted into the proximal end of the needle hub, wherein the proximal end comprises a luer adapter and a septum disposed within the luer adapter, wherein a portion of a wall of the tubular section comprises a hole, a hydrophobic membrane disposed within the hole towards an outside of the plug, and a hydrophilic membrane within the hole towards an inside of the plug, wherein the hydrophilic membrane prevents fluid leakage through the hole, wherein the hydrophobic membrane provides venting of the flashback chamber.~~

~~17. The method of claim 16, wherein the septum comprises a proximal portion disposed outside the luer adapter, a distal portion extending across the tubular section, an intermediate portion between the proximal portion and the distal portion, and a slit extending longitudinally through the proximal portion, the distal portion, and the intermediate portion, wherein a cross-section of the proximal portion, the distal portion, and the intermediate portion forms a general H-shape, wherein the hole is distal to the distal portion of the septum.~~

~~18. The method of claim 12, wherein the plug comprises a distal end, a proximal end, and tubular section disposed between the distal end and the proximal end, wherein the distal end comprises a neck portion extending from the tubular section and a skirt extending from the tubular section to define an annular channel between the~~

~~skirt and the neck portion, wherein the neck portion is inserted into the proximal end of the needle hub, wherein the proximal end comprises a luer adapter and a septum disposed within the luer adapter, wherein a portion of a wall of the tubular section comprises a hole, wherein a porous membrane is disposed within the hole, wherein the porous membrane is configured to pass air but not blood.~~

~~19.~~ ~~The method of claim 18, wherein the septum comprises a proximal portion disposed outside the luer adapter, a distal portion extending across the tubular section, an intermediate portion between the proximal portion and the distal portion, and a slit extending longitudinally through the proximal portion, the distal portion, and the intermediate portion, wherein a cross-section of the proximal portion, the distal portion, and the intermediate portion forms a general H-shape, wherein the hole is distal to the distal portion of the septum.~~

~~20.~~ ~~The method of claim 12, wherein the needle assembly further comprises a grip extending outwardly from the needle hub and distal to the distal end of the needle hub.~~