CLAIMS

1. A dialysis cassette, comprising:

a balance pod comprising:

a first rigid chamber with a first liquid port;

a second rigid chamber with a second liquid port;

a diaphragm captured between the first and second rigid chambers wherein the diaphragm moves between a first position where the diaphragm is near an inner wall of the first rigid chamber and the balance pod being substantially full of a first fluid and a second position where the diaphragm is near an inner wall of the second rigid chamber and the balance pod being substantially full of a second fluid;

a blood leak sensor positioned to detect a characteristic of fluid in the balance pod and arranged to generate a signal for detecting blood in the first fluid when the balance pod is nearly full of the first fluid, and to generate a signal for detecting an absence of blood in the second fluid when the balance pod is nearly full of the second fluid,

wherein the blood leak sensor includes a light emitter arranged to emit light into the balance pod, and a light detector arranged to detect light emitted by the light emitter, and the light detector and light emitter are arranged such that a straight line path from the light emitter to the light detector passes through balance pod.

2. The dialysis cassette of claim 1, wherein the blood leak sensor is arranged to measure a first level for the first fluid when the balance pod is nearly full of the first fluid and a second level for the second fluid when the balance pod is nearly full of the second fluid for comparison of the first and second levels to each other to determine whether blood is present in the first fluid.

3. The dialysis cassette of claim 2, wherein the blood leak sensor is arranged to measure the first level with the balance pod substantially full of the first fluid and substantially empty of the second fluid, and is arranged to measure the second level with the balance pod substantially empty of the first fluid and substantially full of the second fluid.

4. The dialysis cassette of claim 3, wherein the diaphragm is arranged to contact the inner wall of the first rigid chamber when the balance pod is substantially full of the first fluid, and is arranged to contact the inner wall of the second rigid chamber when the balance pod is substantially full of the second fluid.

5. The dialysis cassette of claim 1, wherein the light emitter and the light detector are arranged so that light emitted by the light emitter and received by the light detector passes through the diaphragm.

6. The dialysis cassette of claim 1, wherein the light emitter and the light detector are arranged so that light emitted by the light emitter and received by the light detector passes through the first and second rigid chambers.

7. The dialysis cassette of claim 1, wherein the diaphragm is transparent and the blood leak sensor is arranged to detect light transmitted through the balance pod and at least a part of the diaphragm.

8. The dialysis cassette of claim 7, wherein the light emitter is positioned outside of the balance pod and the light detector is positioned outside of the balance pod.

9. The dialysis cassette of claim 1, wherein the blood leak sensor is arranged to detect blood in a dialysate solution containing blood in a concentration of at least 0.2 ml blood per liter of the dialysate solution.

10. The dialysis cassette of claim 1, wherein the balance pod is a balancing chamber arranged to receive used dialysate from a dialyzer into the second liquid port, and arranged to receive clean dialysate for delivery to the dialyzer into the first liquid port.

11. The dialysis cassette of claim 10, wherein the blood leak sensor is arranged to determine a presence of blood by comparing a light level detected when the balance

pod is substantially full of used dialysate to a light level detected when the balance pod is substantially full of clean dialysate.

12. The dialysis cassette of claim 1, wherein the balance pod has a substantially spherical shape and the diaphragm has a substantially hemispherical shape.

13. The dialysis cassette of claim 1, wherein the light emitter and light detector are arranged on diametrically opposed sides of the balance pod.

14. A method for detecting blood in a dialysate circuit of a dialysis system, comprising:

substantially filling with a first fluid a first portion of a chamber having a movable membrane separating the first portion of the chamber from a second portion of the chamber;

using a light emitter and a light detector on opposed sides of the chamber to transmit light through the first portion of the chamber and

measure a first light level for light transmitted through the first fluid in the first portion;

emptying the first portion of the chamber as the second portion of the chamber is substantially filled with a second fluid;

using the light emitter and the light detector to transmit light through the second portion of the chamber and measure a second light level for light transmitted through the second fluid in the second portion; and

determining a presence of blood in the first fluid in the first portion by comparing the first and second light levels.

15. The method of claim 14, wherein the first fluid is used dialysate and the second fluid is clean dialysate.

16. The method of claim 14, wherein the step of using the light emitter and the light detector to transmit light through the first portion comprises transmitting the light through the second portion and the membrane.

17. The method of claim 14, wherein the step of using the light emitter and the light detector to transmit light through the first portion comprises transmitting the light through a wall of the chamber.

18. A method for detecting blood in a dialysate circuit of a dialysis system, comprising:

providing a chamber having a movable membrane that fluidically separates a first portion of the chamber from a second portion of the chamber;

providing used dialysate received from a dialyzer into the first portion of the chamber;

using a light emitter and a light detector on opposed sides of the chamber to measure a characteristic of the used dialysate in the first portion;

providing clean dialysate into the second portion of the chamber, thereby substantially emptying the first portion of the used dialysate;

using the light emitter and the light detector on opposed sides of the chamber to measure a characteristic of the clean dialysate; and

determining whether blood is present in the used dialysate in the first portion based on a comparison between the measured characteristic of the used dialysate in the first portion and the measured characteristic of the clean dialysate in the second portion.

19. The method of claim 18, wherein the measured characteristic for the used dialysate and the clean dialysate includes an absorption of light by the used dialysate.

20. The method of claim 18, wherein the characteristic of the used dialysate is measured with the first portion substantially filled with used dialysate and the second portion substantially empty, and the characteristic of the clean dialysate is measured with the second portion substantially filled with clean dialysate and the first portion substantially empty.

21. The method of claim 18, wherein the chamber is a balancing chamber of the dialysate circuit in the dialysis system.

22. A method for detecting blood in a dialysate circuit of a dialysis system, comprising:

providing a blood leak sensor positioned to detect a characteristic of fluid in a chamber having a membrane that separates a first portion of the chamber from a second portion of the chamber, the blood leak sensor including a light emitter arranged to emit light into the chamber, and a light detector arranged to detect light emitted by the light emitter, and the light detector and light emitter being arranged such that a straight line path from the light emitter to the light detector passes through the chamber;

using the blood leak sensor to detect a characteristic of clean dialysate in the second portion of the chamber;

using the blood leak sensor to detect a characteristic of used dialysate, received from a dialyzer, in the first portion of the chamber; and

using the detected characteristic of clean dialysate and the detected characteristic of the used dialysate to determine whether blood is present in the used dialysate.

23. The method of claim 22, wherein the step of using the blood leak sensor to detect a characteristic of clean dialysate comprises:

using the blood leak sensor to detect the characteristic of clean dialysate with the second portion of the chamber substantially filled with clean dialysate and the first portion substantially empty.

24. The method of claim 22, wherein the step of using the blood leak sensor to detect a characteristic of clean dialysate comprises:

transmitting light through the clean dialysate to detect the characteristic of the clean dialysate.

25. The method of claim 24, wherein the step of using the detected characteristic of clean dialysate comprises:

comparing the characteristics of the clean dialysate and the used dialysate to determine whether blood is present in the used dialysate.

26. The method of claim 25, wherein the characteristic of the clean dialysate is detected for a condition in which the second portion is substantially filled with clean dialysate, and the characteristic of the used dialysate is detected for a condition in which the first portion is substantially filled with used dialysate.

27. The method of claim 26, further comprising:

operating the chamber to alternately substantially fill the first portion with used dialysate and substantially fill the second portion with clean dialysate;

using the blood leak sensor to detect a characteristic of clean dialysate for each of a plurality of operations that substantially fills the second portion with clean dialysate; and

using the detected characteristic of clean dialysate for each of the plurality of operations to determine whether blood is present for each of a plurality of operations that substantially fills the first portion with used dialysate.

28. The method of claim 25, wherein light transmitted through the used dialysate and the clean dialysate to detect the characteristics passes through the first and second portions of the chamber and the membrane.

29. A method for detecting blood in a dialysate circuit of a dialysis system, comprising:

operating the dialysis system to provide dialysis treatment to a patient by, at least in part, circulating dialysate through a dialysate circuit including a balancing chamber and a dialyzer;

providing a blood leak sensor arranged to determine a presence of blood in used dialysate flowing from the dialyzer to the balancing chamber, the blood leak sensor including a light emitter arranged to emit light into the balancing chamber, and a light detector arranged to detect light emitted by the light emitter, and the light detector and

light emitter being arranged such that a straight line path from the light emitter to the light detector passes through the balancing chamber; and

using the blood leak sensor to measure a characteristic of clean dialysate while the clean dialysate is in the balancing chamber and to measure a characteristic of used dialysate while the used dialysate is in the balancing chamber.

30. The method of claim 29, further comprising:

operating the dialysate circuit to alternately substantially fill the balancing chamber with clean dialysate and with used dialysate;

wherein using the blood leak sensor to measure a characteristic of clean dialysate flowing to the balancing chamber includes operating the blood leak sensor to measure the characteristic of clean dialysate in the balancing chamber when the balancing chamber is substantially filled with clean dialysate.

31. The method of claim 29, further comprising:

using the blood leak sensor to detect a presence of blood in the balancing chamber when the balancing chamber is substantially filled with used dialysate received from the dialyzer.

32. The method of claim 31, wherein a presence of blood in the balancing chamber is determined based on a comparison of the measured characteristic of clean dialysate with a characteristic of used dialysate measured by the blood leak sensor when the balancing chamber is substantially filled with used dialysate.