CLAIMS

1. A tubing state detector for detecting the presence or absence of a tubing segment, comprising:

a first light emitter having a first optical axis directed toward a space in which a tubing segment is to be positioned;

a second light emitter having a second optical axis directed toward the space, the second light emitter being adjacent the first light emitter; and

an optical sensor positioned on a side of the space opposite the first and second light emitters and arranged to receive light emitted by the first and second light emitters to determine a presence or absence of a tubing segment in the space.

2. The detector of claim 1, wherein the second optical axis is approximately parallel to the first optical axis.

3. The detector of claim 1, wherein the optical sensor detects a higher or lower light level from the first light emitter when a tubing segment is in the space.

4. The detector of claim 3, wherein the optical sensor detects a lower light level from the second light emitter when a tubing segment is in the space.

5. The detector of claim 1, wherein with a tubing segment in the space, a detected light level for both the first and second light emitters is within about 15-20% of a calibration light level for the first and second light emitters that is detected when a tubing segment is known to be absent from the space.

6. The detector of claim 5, wherein with a tubing segment not in the space, a detected light level for the second light emitter is less than about 15-20% of the calibration light level for the second light emitter.

7. The detector of claim 1, wherein the optical sensor has an optical axis that is approximately collinear with the first optical axis.

8. The detector of claim 1, wherein the first optical axis passes approximately through a center of a tubing segment with the tubing segment positioned in the space.

9. The detector of claim 8, wherein the second optical axis is offset from a center of a tubing segment with the tubing segment positioned in the space.

10. The detector of claim 1, wherein the optical sensor has a sensor optical axis, the detector further comprising a third light emitter having a third optical axis that is arranged at an oblique angle relative to the sensor optical axis.

11. The detector of claim 10, wherein the oblique angle is about 110-120 degrees.

12. The detector of claim 10, wherein the optical sensor and third light emitter are arranged such that with a tubing segment in the space and the tubing segment containing no liquid, a light level detected by the optical sensor is over about 150% of a calibration light level detected with no tubing segment in the space, and such that with a tubing segment in the space and the tubing segment containing liquid, a light level detected by the optical sensor is less than about 125% of the calibration light level.

13. The detector of claim 10, wherein the optical sensor and third light emitter are arranged such that with a tubing segment in the space and the tubing segment containing no liquid, a light level detected by the optical sensor is over a threshold level, and such that with a tubing segment in the space and the tubing segment containing liquid, a light level detected by the optical sensor is less than the threshold level.

14. The detector of claim 13, wherein the threshold level is about 125-150% of a light level detected by the optical sensor with no tubing segment in the space.

15. The detector of claim 10, wherein the third light emitter and the optical sensor are arranged such that the optical sensor receives light from the third light emitter both when a tubing segment in the space is filled with liquid and when a tubing segment in the space is empty of liquid.

16. The detector of claim 10, wherein the space is arranged to receive and hold a tubing segment having a cylindrical outer surface without substantially deforming the tubing segment.

17. The detector of claim 1, wherein the first and second light emitters are light emitting diodes.

18. The detector of claim 1, wherein the tubing segment is a portion of a patient line of a dialysis system.

19. The detector of claim 1, wherein the tubing segment is at a distal end of the patient line.

~~20. A tubing state detector for detecting whether liquid is contained in a tubing segment, comprising:~~

~~a fill state light emitter having an optical axis that is arranged to pass through a space in which a tubing segment is to be positioned, the space being arranged to receive a tubing segment having a cylindrical outer surface and to hold the tubing segment without substantially deforming the tubing segment ; and~~

~~an optical sensor positioned on a side of the space opposite the fill state light emitter and arranged to receive light emitted by the fill state light emitter to determine a presence or absence of liquid in the tubing segment, the optical sensor having a sensor optical axis that is arranged at an oblique angle to the optical axis of the fill state light emitter.~~

~~21. The detector of claim 20, wherein the oblique angle is about 110-120 degrees.~~

~~22. The detector of claim 20, wherein the optical sensor and fill state light emitter are arranged such that with a tubing segment in the space and the tubing segment containing no liquid, a light level detected by the optical sensor is over about 150% of a calibration light level detected with no tubing segment in the space, and such that with a tubing segment in the space and the tubing segment containing liquid, a light level detected by the optical sensor is less than about 125% of the calibration light level.~~

~~23. The detector of claim 20, wherein the optical sensor and fill state light emitter are arranged such that with a tubing segment in the space and the tubing segment containing no liquid, a light level detected by the optical sensor is over a threshold level, and such that with a tubing segment in the space and the tubing segment containing liquid, a light level detected by the optical sensor is less than the threshold level.~~

~~24. The detector of claim 23, wherein the threshold level is about 125-150% of a light level detected by the optical sensor with no tubing segment in the space.~~

~~25. The detector of claim 20, wherein the fill state light emitter is a light emitting diode.~~

~~26. The detector of claim 20, further comprising:~~

~~a first light emitter having a first optical axis directed toward a space in which a tubing segment is to be positioned; and~~

~~a second light emitter having a second optical axis directed toward the space, the second light emitter being adjacent the first light emitter,~~

~~wherein the optical sensor is positioned on a side of the space opposite the first and second light emitters and arranged to receive light emitted by the first and second light emitters to determine a presence or absence of a tubing segment in the space.~~

~~27. The detector of claim 26, wherein the second optical axis is approximately parallel to the first optical axis.~~

~~28. The detector of claim 26, wherein the optical sensor detects a higher or lower light level from the first light emitter when a tubing segment is in the space.~~

~~29. The detector of claim 28, wherein the optical sensor detects a lower light level from the second light emitter when a tubing segment is in the space.~~

~~30. The detector of claim 26, wherein with a tubing segment in the space, a detected light level for both the first and second light emitters is within about 15-20% of a calibration light level for the first and second light emitters that is detected when a tubing segment is known to be absent from the space.~~

~~31. The detector of claim 30, wherein with a tubing segment not in the space, a detected light level for the second light emitter is less than about 15-20% of the calibration light level for the second light emitter.~~

~~32. The detector of claim 26, wherein the optical sensor has an optical axis that is approximately collinear with the first optical axis.~~

~~33. The detector of claim 26, wherein the first optical axis passes approximately through a center of a tubing segment with the tubing segment positioned in the space.~~

~~34. The detector of claim 33, wherein the second optical axis is offset from a center of a tubing segment with the tubing segment positioned in the space.~~

~~35. The detector of claim 20, wherein the fill state light emitter and the optical sensor are arranged such that the optical sensor receives light from the fill state light emitter both when a tubing segment in the space is filled with liquid and when a tubing segment in the space is empty of liquid.~~

~~36. The detector of claim 20, wherein the space is arranged to receive and hold a tubing segment having a cylindrical outer surface without substantially deforming the tubing segment.~~

~~37. The detector of claim 20, wherein the tubing segment is a portion of a patient line of a dialysis system.~~

~~38. The detector of claim 37, wherein the tubing segment is at a distal end of the patient line.~~

~~39. The detector of claim 38, wherein the tubing segment is a portion of a connector used to connect the patient line to a patient access connection.~~

~~40. A peritoneal dialysis system, comprising:~~

~~at least one pump arranged to pump dialysate for delivery to a peritoneal cavity of a patient;~~

~~a patient line fluidly coupled to the at least one pump such that dialysate delivered from the pump is directed to the patient line, the patient line having a distal end arranged for connection to a patient; and~~

~~a patient line state detector arranged to be associated with the patient line and to detect both a presence of the patient line and a priming condition of the patient line.~~

~~41. The system of claim 40, wherein the patient line state detector is arranged to receive the distal end of the patient line to detect the presence of the distal end and whether the distal end of the patient line is filled with fluid.~~

~~42. The system of claim 41, wherein the patient line state detector includes:~~

~~a cavity to receive the distal end of the patient line;~~

~~one or more light emitters associated with the cavity arranged to direct light into the cavity; and~~

~~one or more light detectors arranged to detect light emitted by the one or more light emitters.~~

~~43. The system of claim 40, wherein the patient line state detector includes:~~

~~a first light emitter having a first optical axis directed toward a space in which a portion of the patient line is to be positioned;~~

~~a second light emitter having a second optical axis directed toward the space, the second light emitter being adjacent the first light emitter; and~~

~~an optical sensor positioned on a side of the space opposite the first and second light emitters and arranged to receive light emitted by the first and second light emitters to determine a presence or absence of the patient line in the space.~~

~~44. The system of claim 43, wherein the second optical axis is approximately parallel to the first optical axis.~~

~~45. The system of claim 43, wherein the optical sensor detects a higher or lower light level from the first light emitter when a portion of the patient line is in the space.~~

~~46. The system of claim 45, wherein the optical sensor detects a lower light level from the second light emitter when a portion of the patient line is in the space.~~

~~47. The system of claim 43, wherein with a portion of the patient line in the space, a detected light level for both the first and second light emitters is within about 15-20% of a calibration light level for the first and second light emitters that is detected when a tubing segment is known to be absent from the space.~~

~~48. The system of claim 47, wherein with a portion of the patient line not in the space, a detected light level for the second light emitter is less than about 15-20% of the calibration light level for the second light emitter.~~

~~49. The system of claim 43, wherein the optical sensor has an optical axis that is approximately collinear with the first optical axis.~~

~~50. The system of claim 43, wherein the first optical axis passes approximately through a center of a portion of the patient line with the portion of the patient line positioned in the space.~~

~~51. The system of claim 50, wherein the second optical axis is offset from a center of a portion of the patient line with the portion of the patient line positioned in the space.~~

~~52. The system of claim 43, wherein the optical sensor has a sensor optical axis, the detector further comprising a third light emitter having a third optical axis that is arranged at an oblique angle relative to the sensor optical axis.~~

~~53. The system of claim 52, wherein the oblique angle is about 110-120 degrees.~~

~~54. The system of claim 52, wherein the optical sensor and third light emitter are arranged such that with a portion of the patient line in the space and the portion of the patient line containing no liquid, a light level detected by the optical sensor is over about 150% of a calibration light level detected with no portion of the patient line in the space, and such that with a portion of the patient line in the space and the portion of the patient line containing~~

~~liquid, a light level detected by the optical sensor is less than about 125% of the calibration light level.~~

~~55. The system of claim 52, wherein the optical sensor and third light emitter are arranged such that with a portion of the patient line in the space and the portion of the patient line containing no liquid, a light level detected by the optical sensor is over a threshold level, and such that with a portion of the patient line in the space and the portion of the patient line containing liquid, a light level detected by the optical sensor is less than the threshold level.~~

~~56. The system of claim 55, wherein the threshold level is about 125-150% of a light level detected by the optical sensor with no a portion of the patient line in the space.~~

~~57. The system of claim 43, wherein the portion of the patient line is a distal end of the patient line.~~

~~58. The system of claim 40, wherein the first and second light emitters are light emitting diodes.~~

~~59. The system of claim 40, wherein a portion of the patient line associated with the patient line state detector has a cylindrical outer surface and the patient line state detector is arranged to receive and hold the patient line without substantially deforming the patient line.~~

~~60~~20. A method for detecting a presence of a tubing segment, comprising:

emitting first light along a first optical axis toward a space in which a tubing segment is to be optionally positioned;

emitting second light along a second optical axis toward the space, the first and second light being emitted from a first side of the space;

sensing at least portions of the first and second light on a second side of the space opposite the first side; and

determining a presence or absence of a tubing segment in the space based on the sensed portions of the first and second light.

~~61~~21. The method of claim ~~60~~20, wherein the second optical axis is approximately parallel to the first optical axis.

~~62~~22. The method of claim ~~60~~20, wherein a first calibration level of the first light is detected with no tubing segment in the space, and a first light level is detected of the first light when a tubing segment is in the space, where the first light level is higher or lower than the first calibration level.

~~63~~23. The method of claim ~~60~~20, wherein a second calibration level of the second light is detected with no tubing segment in the space, and a second light level is detected of the second light when a tubing segment is in the space, where the second light level is lower than the second calibration level.

~~64~~24. The method of claim ~~63~~23, wherein a determination is made that a tubing segment is in the space when a detected light level for the second light is less than about 15-20% of the second calibration level.

~~65~~25. The method of claim ~~60~~20, wherein the first optical axis passes approximately through a center of a tubing segment with the tubing segment positioned in the space.

~~66~~26. The method of claim ~~60~~20, wherein the second optical axis is offset from a center of a tubing segment with the tubing segment positioned in the space.

~~67~~27. The method of claim ~~60~~20, further comprising determining whether liquid is present in the tubing segment or not.

~~68~~28. The method of claim ~~60~~20, wherein the step of determining whether liquid is present in the tubing segment or not comprises detecting a third light level using a same optical sensor used to detect at least a portion of the first and second light.

~~69~~29. The method of claim ~~68~~28, wherein the third light level is detected based on light emitted along an optical axis that is oblique to a sensor optical axis along which the third light level is detected.

~~70. . A method for detecting a presence of liquid in a tubing segment, comprising:~~

~~emitting light along an optical axis toward a space in which a tubing segment is positioned, the tubing segment having a cylindrical outer surface;~~

~~sensing light along a sensor optical axis that extends into the space, wherein the sensor optical axis is arranged at an oblique angle relative to the optical axis; and~~

~~determining a presence or absence of liquid in the tubing segment in the space based on a sensed light level sensed along the sensor optical axis.~~

~~71. The method of claim 70, wherein the oblique angle is about 110-120 degrees.~~

~~72. The method of claim 70, further comprising:~~

~~emitting light along the optical axis without a tubing segment in the space;~~

~~sensing light along the sensor optical axis while light is emitted along the optical axis without a tubing segment in the space; and~~

~~determining a calibration level of light detected along the sensor optical axis without a tubing segment in the space.~~

~~73. The method of claim 72, wherein the step of determining a presence or absence of liquid in the tubing segment includes comparing the sensed light level to the calibration level.~~

~~74. The method of claim 73, wherein a light level detected along the sensor optical axis with a tubing segment in the space containing no liquid is over about 150% of the calibration, and a light level detected along the sensor optical axis is less than about 125% of the calibration level with a tubing segment in the space containing liquid.~~

~~75. The method of claim 70, wherein the step of determining comprises:~~

~~determining that fluid is not present in the tubing segment if a light level detected along the sensor optical axis is over a threshold level, and determining that fluid is present in the tubing segment if a light level detected along the sensor optical axis is below a threshold level.~~

~~76. The method of claim 76, wherein the threshold level is about 125-150% of a calibration level detected along the sensor optical axis with no tubing segment in the space.~~