CLAIMS

1. A method to monitor fluid flow through a catheter assembly, the method comprising:

providing a clamp comprising:

an open position and a closed position, wherein the open position permits a fluid to flow through an extension tube positioned within the clamp, and wherein the closed position prevents a fluid from flowing through an extension tube positioned within the clamp;

a clamping surface in which is embedded an acoustic sensor, wherein the acoustic sensor is configured to contact an extension tube of a catheter assembly when the clamp is in either the closed or open positions, and to detect whether a fluid is flowing through an extension tube positioned within the clamp, wherein the clamp and the acoustic sensor are disposed outside of the extension tube; and

detecting, via the acoustic sensor, a fluid flowing through the extension tube.

2. The method of claim 1, wherein detecting, via the acoustic sensor, the fluid flowing through the extension tube comprises detecting, via the acoustic sensor, a frequency of the fluid flowing through the extension tube, an amplitude of the fluid flowing through the extension tube, or sound energy of the fluid flowing through the extension tube.

3. The method of claim 1, wherein detecting, via the acoustic sensor, the fluid flowing through the extension tube comprises detecting, via the acoustic sensor, a frequency between 80 Hz and 200 Hz.

4. The method of claim 1, further comprising detecting, via the acoustic sensor, that the fluid is not flowing through the extension tube by detecting, via the acoustic sensor, a frequency between 40 Hz and 80 Hz.

5. The method of claim 4, further comprising:

in response to detecting, via the acoustic sensor, that the fluid is not flowing through the extension tube, starting a timer; and

in response to the timer reaching a first predetermined duration of time, providing a first alert.

6. The method of claim 5, wherein providing the first alert comprises transmitting a first alert signal over a network to a monitoring device, wherein the first alert signal indicates to the monitoring device to provide the first alert.

7. The method of claim 5, further comprising providing an indication in an electronic health record of a patient in response to the timer reaching the first predetermined duration of time.

8. The method of claim 5, further comprising in response to detecting, via the acoustic sensor, the fluid flowing through the extension tube for a second predetermined duration of time, stopping or resetting the timer.

9. The method of claim 8, further comprising in response to the acoustic sensor detecting, via the acoustic sensor, fluid flowing through the extension tube for the second predetermined duration of time, transmitting a second alert signal over the network to the monitoring device, wherein the second alert signal indicates to the monitoring device to stop the first alert or provide a second alert.

10. The method of claim 5, further comprising in response to the timer reaching the second predetermined duration of time, providing a second alert.

11. The method of claim 10, wherein the second predetermined duration of time is greater than the first predetermined duration of time and corresponds to a time to flush the catheter assembly, wherein the second predetermined duration of time is between six hours and eight hours.

12. The method of claim 1, further comprising providing an indication in an electronic health record of a patient in response to detecting fluid, via the acoustic sensor, the fluid is flowing or not flowing through the extension tube.

13. The method of claim 1, wherein the clamp comprises a second acoustic sensor configured to detect fluid flowing through the extension tube, wherein the second acoustic sensor is disposed outside of the extension tube, wherein the acoustic sensor is disposed distal to the second acoustic sensor, further comprising determining a fluid flow direction in response to the detecting, via the acoustic sensor, that the fluid is flowing through the extension tube prior to or after detecting, via the second acoustic sensor, that the fluid is flowing through the extension tube.

14. The method of claim 1, wherein the clamp is a pinch clamp.

15. A catheter assembly, comprising:

a catheter adapter;

an extension tube coupled to the catheter adapter; and

a clamp having an open position and a closed position, wherein the open position permits a fluid to flow through the extension tube, and wherein the closed position prevents a fluid from flowing through the extension tube, the clamp comprising a clamping surface in which is embedded an acoustic sensor configured to contact the extension tube when the clamp is in either the closed or open positions, and to detect whether the fluid is flowing through the extension tube.

16. The catheter assembly of claim 15, wherein the clamp comprises a pinch clamp.

17. The method of claim 1 or the catheter assembly of claim 15, wherein the acoustic sensor is a microphone.

18. A catheter assembly, comprising:

a catheter adapter;

an extension tube coupled to the catheter adapter; and

a clamp having an open position and a closed position, wherein the open position permit a fluid to flow through an extension tube positioned within the clamp, and wherein the closed position prevents a fluid from flowing through an extension tube, the clamp comprising a surface in which is embedded an acoustic sensor configured to contact to an extension tube when the clamp is in either the closed or open positions and, to detect whether the fluid is flowing through the extension tube,

wherein the acoustic sensor is to measure a frequency between 40 Hz and 80 Hz to detect that the fluid is not flowing through the extension tube, or is to measure a frequency between 80 Hz and 200 Hz to detect that the fluid is flowing through the extension tube.

19. The catheter assembly of claim 18, wherein the clamp comprises a pinch clamp.

20. The catheter assembly of claim 18, further comprising a timer starting in response to the acoustic sensor detecting that the fluid is not flowing through the extension tube, and providing an alert in response to the timer reaching a predetermined duration of time.

21. The catheter assembly of claim 18, wherein the clamp comprises a second acoustic sensor configured to detect fluid flowing through the extension tube, wherein the second acoustic sensor is disposed outside of the extension tube, wherein the acoustic sensor is disposed distal to the second acoustic sensor, further comprising determining a fluid flow direction in response to the detecting, via the acoustic sensor, the fluid is flowing through the extension tube prior to or after detecting, via the second acoustic sensor, the fluid is flowing through the extension tube.