CLAIMS

1. A system for controlling flow of a liquid to a patient through use of an intravenous delivery system, the system comprising:

a flow rate sensor that:

measures a flow rate of the liquid through the intravenous delivery system; and

generates a flow rate signal indicative of the flow rate;

a controller that:

receives the flow rate signal;

compares the flow rate with a desired flow rate to determine that the flow rate is different from the desired flow rate; and

in response to determining that the flow rate is different from the desired flow rate, transmits a control signal; and

a flow rate regulator, comprising:

a frame;

an opposing member attached to the frame, the opposing member comprising a curved rim configured to abut tubing of the system that conveys the liquid;

a cam member, comprising a variable radius curved rim configured to abut the tubing, wherein the variable radius curved rim has a maximum diameter portion and a minimum diameter portion;

a motor configured to rotate the cam member with respect to the frame, wherein in response to the motor rotating the cam member to orient the minimum diameter portion proximate the tubing, the cam member and the opposing member cooperate to exert a first amount of pinching on the tubing, wherein in response to the motor rotating the cam member to orient the maximum diameter portion proximate the tubing, the cam member and the opposing member cooperate to exert a second amount of pinching on the tubing, wherein the second amount of pinching is greater than the first amount of pinching;

wherein in response to receipt of the control signal, the motor rotates the cam member to modify the flow rate to bring the flow rate closer to the desired flow rate.

2. The system of claim 1, wherein the flow rate sensor, the controller, and the flow rate regulator all operate iteratively throughout a plurality of time increments such that, in each of the

plurality of time increments, the flow rate sensor measures the flow rate and generates the flow rate signal, and the controller receives the flow rate signal and compares the flow rate with the desired flow rate;

wherein the controller determines that the flow rate is different from the desired flow rate by determining that the flow rate is greater than the desired flow rate;

wherein, in response to receipt of the control signal, the flow rate regulator:

modifies the flow rate by moving from an open state that permits the liquid to flow through the intravenous delivery system, to a closed state that substantially prevents the liquid from flowing through the intravenous delivery system; and

remains in the closed state for a predetermined number of the time increments.

3. The system of claim 1, wherein the flow rate sensor, the controller, and the flow rate regulator all operate iteratively throughout a plurality of time increments such that, in each of the plurality of time increments, the flow rate sensor measures the flow rate and generates the flow rate signal, and the controller receives the flow rate signal and compares the flow rate with the desired flow rate;

wherein the controller determines that the flow rate is different from the desired flow rate by determining that the flow rate is less than the desired flow rate;

wherein, in response to receipt of the control signal, the flow rate regulator:

modifies the flow rate by moving from a closed state that substantially prevents the liquid from flowing through the intravenous delivery system, to an open state in that permits the liquid to flow through the intravenous delivery system; and

remains in the open state for a predetermined number of the time increments.

4. The system of claim 1, wherein the controller determines that the flow rate is different from the desired flow rate by determining that the flow rate is greater than the desired flow rate by a differential flow rate;

wherein, in response to receipt of the control signal, the flow rate regulator moves, in proportion to the differential flow rate, to a less open state that permits the liquid to flow through the intravenous delivery system at a modified flow rate smaller than the flow rate.

5. The system of claim 1, wherein the controller determines that the flow rate is different from the desired flow rate by determining that the flow rate is less than the desired flow rate by a differential flow rate;

wherein, in response to receipt of the control signal, the flow rate regulator moves, in proportion to the differential flow rate, to a more open state that permits the liquid to flow through the intravenous delivery system at a modified flow rate greater than the flow rate.

6. The system of claim 1, wherein the controller is incorporated into a computing device comprising a display screen and a user input device, wherein the controller further:

receives the desired flow rate from a user via the user input device; and

initiates display of the flow rate on the display screen.

7. The system of claim 1, wherein the flow rate sensor is secured to a drip unit of the intravenous delivery system, wherein the drip unit comprises a drip chamber and an orifice that delivers drops of the liquid from a liquid source to the drip chamber via gravity feed, wherein the flow rate sensor measures the flow rate by counting drops received by the drip chamber within a predetermined time period.

8. The system of claim 7, further comprising the drip unit;

wherein the drip unit comprises a key feature indicative of an orifice size of the orifice;

wherein the flow rate sensor comprises a key feature receiver that receives the key feature in response to securement of the flow rate sensor to the drip unit;

wherein the flow rate sensor uses the orifice size to determine a volume of the liquid in each of the drops to facilitate measurement of the flow rate.

9. The system of claim 1, wherein the flow rate sensor measures the flow rate of the liquid through the system by:

measuring a first weight of a subset of the intravenous delivery system at a first time; and

measuring a second weight of the subset at a second time separated from the first time by a time increment;

wherein at least one of the flow rate sensor and the controller:

subtracts the second weight from the first weight to obtain a differential weight; and

obtains the flow rate based on the differential weight and the time increment.

10. The system of claim 1, wherein the flow rate sensor measures the flow rate of the liquid through the system by:

measuring a first volume of the liquid in a subset of the intravenous delivery system at a first time; and

measuring a second volume of the liquid in the subset at a second time separated from the first time by a time increment;

wherein at least one of the flow rate sensor and the controller:

subtracts the second volume from the first volume to obtain a differential volume; and

obtains the flow rate based on the differential volume and the time increment.

11. The system of claim 10, wherein the flow rate sensor measures the flow rate of the liquid through the system by:

measuring a first temperature of the liquid at a first location within the intravenous delivery system; and

measuring a second temperature of the liquid at a second location, downstream of the first location, within the intravenous delivery system;

wherein at least one of the flow rate sensor and the controller:

subtracts the second temperature from the first temperature to obtain a differential temperature; and

obtains the flow rate based on the differential temperature.

12. The system of claim 1, wherein the intravenous delivery system comprises tubing that conveys the liquid, wherein the flow rate regulator comprises:

an opposing member positioned adjacent to the tubing;

a cam member positioned on an opposite side of the tubing from the opposing member; and

a motor that rotates the cam member about an axis;

wherein the cam member comprises a variable radius curved rim that, in response to rotation of the cam member about the axis, cooperates with the opposing member to exert a varying degree of compression on the tubing to modify the flow rate.

~~12.~~13. The system of claim 1, further comprising the intravenous delivery system, wherein the intravenous delivery system comprises:

a drip unit that receives the liquid from a liquid source via gravity feed;

tubing comprising:

a first end connectable to the drip unit to receive the liquid from the drip unit via gravity feed; and

a second end; and

an intravenous access unit connectable to the second end of the tubing, wherein the intravenous access unit is configured to receive the liquid from the second end via gravity feed and deliver the liquid intravenously to a patient.

~~13.~~14. A method for controlling flow of a liquid ~~to a patient~~ through ~~use of~~ an intravenous delivery system, the method comprising:

with a flow rate sensor:

measuring a flow rate of the liquid through the intravenous delivery system; and

generating a flow rate signal indicative of the flow rate;

with a controller:

receiving the flow rate signal;

comparing the flow rate with a desired flow rate to determine that the flow rate is different from the desired flow rate; and

in response to determining that the flow rate is different from the desired flow rate, transmitting a control signal; and

with a flow rate regulator:

receiving the control signal; and

in response to receipt of the control signal, modifying the flow rate to bring the flow rate closer to the desired flow rate, wherein the flow rate regulator comprises:

a frame;

an opposing member attached to the frame, the opposing member comprising a curved rim configured to abut tubing of the system that conveys the liquid;

a cam member, comprising a variable radius curved rim configured to abut the tubing, wherein the variable radius curved rim has a maximum diameter portion and a minimum diameter portion; and

a motor configured to rotate the cam member with respect to the frame, wherein in response to the motor rotating the cam member to orient the minimum diameter portion proximate the tubing, the cam member and the opposing member cooperate to exert a first amount of pinching on the tubing, wherein in response to the motor rotating the cam member to orient the maximum diameter portion proximate the tubing, the cam member and the opposing member cooperate to exert a second amount of pinching on the tubing, wherein the second amount of pinching is greater than the first amount of pinching.

~~14.~~15. The method of claim 14, wherein measuring the flow rate, generating the flow rate signal, receiving the flow rate signal, and comparing the flow rate with the desired flow rate are all carried out iteratively throughout a plurality of time increments such that, in each of the plurality of time increments, the flow rate is measured, the flow rate signal is generated, the flow rate signal is received, and the flow rate is compared with the desired flow rate;

wherein modifying the flow rate comprises moving the flow rate regulator from one of an open state that permits the liquid to flow through the intravenous delivery system, and a closed state that substantially prevents the liquid from flowing through the intravenous delivery system, to the other of the open state and the closed state;

wherein the method further comprises causing the flow rate regulator to remain in the other of the open state and the closed state for a predetermined number of the time increments.

~~15.~~16. The method of claim 14, wherein determining that the flow rate is different from the desired flow rate comprises determining that the flow rate differs from the desired flow rate by a differential flow rate;

wherein modifying the flow rate comprises moving the flow rate regulator in proportion to the differential flow rate to perform one of increasing the flow rate and decreasing the flow rate.

~~16.~~17. The method of claim 14, wherein the controller is incorporated into a computing device comprising a display screen and a user input device, the method further comprising:

via the user input device, and prior to comparing the flow rate with the desired flow rate, receiving the desired flow rate from a user; and

via the display screen and after generating the flow rate signal, initiating display of the flow rate.

~~17.~~18. A system for controlling flow of a liquid to a patient, the system comprising:

a drip unit comprising a drip chamber and an orifice that delivers drops of the liquid from a liquid source to the drip chamber via gravity feed;

a flow rate sensor configured to be coupled to the drip unit, wherein the flow rate sensor:

measures a flow rate of the liquid through the drip chamber; and

generates a flow rate signal indicative of the flow rate;

a controller that:

receives the flow rate signal;

compares the flow rate with a desired flow rate to determine that the flow rate is different from the desired flow rate; and

in response to determining that the flow rate is different from the desired flow rate, transmits a control signal;

tubing comprising:

a first end connectable to the drip unit to receive the liquid from the drip unit via gravity feed; and

a second end;

a flow rate regulator configured to be coupled to the tubing, wherein the flow rate regulator:

receives the control signal; and

in response to receipt of the control signal, adjusts a level of compression applied to the tubing to modify the flow rate to bring the flow rate closer to the desired flow rate, wherein the flow rate regulator comprises:

a frame;

an opposing member attached to the frame, the opposing member comprising a curved rim configured to abut tubing of the system that conveys the liquid;

a cam member, comprising a variable radius curved rim configured to abut the tubing, wherein the variable radius curved rim has a maximum diameter portion and a minimum diameter portion;

a motor configured to rotate the cam member with respect to the frame, wherein in response to the motor rotating the cam member to orient the minimum diameter portion proximate the tubing, the cam member and the opposing member cooperate to exert a first amount of pinching on the tubing, wherein in response to the motor rotating the cam member to orient the maximum diameter portion proximate the tubing, the cam member and the opposing member cooperate to exert a second amount of pinching on the tubing, wherein the second amount of pinching is greater than the first amount of pinching; and

an intravenous access unit connectable to the second end of the tubing, wherein the intravenous access unit is configured to receive the liquid from the second end via gravity feed and deliver the liquid intravenously to a patient.

~~18.~~19. The system of claim 18, wherein the controller is incorporated into a computing device comprising a display screen and a user input device, wherein the controller further:

receives the desired flow rate from a user via the user input device; and

initiates display of the flow rate on the display screen.

20. A system for controlling flow of a liquid to a patient through use of an intravenous delivery system, the system comprising:

a flow rate sensor that:

measures a flow rate of the liquid through the intravenous delivery system; and

generates a flow rate signal indicative of the flow rate;

a controller that:

receives the flow rate signal;

compares the flow rate with a desired flow rate to determine that the flow rate is different from the desired flow rate; and

in response to determining that the flow rate is different from the desired flow rate, transmits a control signal; and

a flow rate regulator, comprising:

a fixture comprising a slot configured to be oriented nonparallel and nonperpendicular to tubing of the system that conveys the liquid;

a pinching member positioned in the slot;

a rack rigidly secured to the pinching member such that the pinching member is translated along the slot and rotates in response to linear motion of the rack, wherein the pinching member is configured to exert a varying degree of compression on the tubing when the pinching member is translated along the slot to modify the flow rate; and

a pinion coupled to a motor, wherein rotation of the pinion by the motor causes the linear motion of the rack,

wherein in response to receipt of the control signal, the pinching member exerts a compression on the tubing to modify the flow rate.

21. The system of claim 20, wherein the flow rate sensor, the controller, and the flow rate regulator all operate iteratively throughout a plurality of time increments such that, in each of the plurality of time increments, the flow rate sensor measures the flow rate and generates the flow rate signal, and the controller receives the flow rate signal and compares the flow rate with the desired flow rate;

wherein the controller determines that the flow rate is different from the desired flow rate by determining that the flow rate is greater than the desired flow rate;

wherein, in response to receipt of the control signal, the flow rate regulator:

modifies the flow rate by moving from an open state that permits the liquid to flow through the intravenous delivery system, to a closed state that substantially prevents the liquid from flowing through the intravenous delivery system; and

remains in the closed state for a predetermined number of the time increments.

22. The system of claim 20, wherein the flow rate sensor, the controller, and the flow rate regulator all operate iteratively throughout a plurality of time increments such that, in each of the plurality of time increments, the flow rate sensor measures the flow rate and generates the flow rate signal,

and the controller receives the flow rate signal and compares the flow rate with the desired flow rate;

wherein the controller determines that the flow rate is different from the desired flow rate by determining that the flow rate is less than the desired flow rate;

wherein, in response to receipt of the control signal, the flow rate regulator:

modifies the flow rate by moving from a closed state that substantially prevents the liquid from flowing through the intravenous delivery system, to an open state in that permits the liquid to flow through the intravenous delivery system; and

remains in the open state for a predetermined number of the time increments.

23. The system of claim 20, wherein the controller determines that the flow rate is different from the desired flow rate by determining that the flow rate is greater than the desired flow rate by a differential flow rate;

wherein, in response to receipt of the control signal, the flow rate regulator moves, in proportion to the differential flow rate, to a less open state that permits the liquid to flow through the intravenous delivery system at a modified flow rate smaller than the flow rate.

24. The system of claim 20, wherein the controller determines that the flow rate is different from the desired flow rate by determining that the flow rate is less than the desired flow rate by a differential flow rate;

wherein, in response to receipt of the control signal, the flow rate regulator moves, in proportion to the differential flow rate, to a more open state that permits the liquid to flow through the intravenous delivery system at a modified flow rate greater than the flow rate.

25. The system of claim 20, wherein the controller is incorporated into a computing device comprising a display screen and a user input device, wherein the controller further:

receives the desired flow rate from a user via the user input device; and

initiates display of the flow rate on the display screen.

26. The system of claim 20, wherein the flow rate sensor is secured to a drip unit of the intravenous delivery system, wherein the drip unit comprises a drip chamber and an orifice that delivers drops of the liquid from a liquid source to the drip chamber via gravity feed, wherein the flow rate sensor

measures the flow rate by counting drops received by the drip chamber within a predetermined time period.

27. The system of claim 26, further comprising the drip unit;

wherein the drip unit comprises a key feature indicative of an orifice size of the orifice;

wherein the flow rate sensor comprises a key feature receiver that receives the key feature in response to securement of the flow rate sensor to the drip unit;

wherein the flow rate sensor uses the orifice size to determine a volume of the liquid in each of the drops to facilitate measurement of the flow rate.

28. The system of claim 20, wherein the flow rate sensor measures the flow rate of the liquid through the system by:

measuring a first weight of a subset of the intravenous delivery system at a first time; and measuring a second weight of the subset at a second time separated from the first time by a time increment;

wherein at least one of the flow rate sensor and the controller:

subtracts the second weight from the first weight to obtain a differential weight; and

obtains the flow rate based on the differential weight and the time increment.

29. The system of claim 20, wherein the flow rate sensor measures the flow rate of the liquid through the system by:

measuring a first volume of the liquid in a subset of the intravenous delivery system at a first time; and

measuring a second volume of the liquid in the subset at a second time separated from the first time by a time increment;

wherein at least one of the flow rate sensor and the controller:

subtracts the second volume from the first volume to obtain a differential volume; and

obtains the flow rate based on the differential volume and the time increment.

30. The system of claim 29, wherein the flow rate sensor measures the flow rate of the liquid through the system by:

measuring a first temperature of the liquid at a first location within the intravenous delivery system; and

measuring a second temperature of the liquid at a second location, downstream of the first location, within the intravenous delivery system;

wherein at least one of the flow rate sensor and the controller:

subtracts the second temperature from the first temperature to obtain a differential temperature; and

obtains the flow rate based on the differential temperature.

31. The system of claim 20, wherein the intravenous delivery system comprises tubing that conveys the liquid, wherein the flow rate regulator comprises:

an opposing member positioned adjacent to the tubing;

a cam member positioned on an opposite side of the tubing from the opposing member; and

a motor that rotates the cam member about an axis;

wherein the cam member comprises a variable radius curved rim that, in response to rotation of the cam member about the axis, cooperates with the opposing member to exert a varying degree of compression on the tubing to modify the flow rate.

32. The system of claim 20, further comprising the intravenous delivery system, wherein the intravenous delivery system comprises:

a drip unit that receives the liquid from a liquid source via gravity feed;

tubing comprising:

a first end connectable to the drip unit to receive the liquid from the drip unit via gravity feed; and

a second end; and

an intravenous access unit connectable to the second end of the tubing, wherein the intravenous access unit is configured to receive the liquid from the second end via gravity feed and deliver the liquid intravenously to a patient.

33. A method for controlling flow of a liquid through an intravenous delivery system, the method comprising:

with a flow rate sensor:

measuring a flow rate of the liquid through the intravenous delivery system; and

generating a flow rate signal indicative of the flow rate;

with a controller:

receiving the flow rate signal;

comparing the flow rate with a desired flow rate to determine that the flow rate is different from the desired flow rate; and

in response to determining that the flow rate is different from the desired flow rate, transmitting a control signal; and

with a flow rate regulator:

receiving the control signal; and

in response to receipt of the control signal, modifying the flow rate to bring the flow rate closer to the desired flow rate, wherein the flow rate regulator comprises:

a fixture comprising a slot configured to be oriented nonparallel and nonperpendicular to tubing of the system that conveys the liquid;

a pinching member positioned in the slot;

a rack rigidly secured to the pinching member such that the pinching member is translated along the slot and rotates in response to linear motion of the rack, wherein the pinching member is configured to exert a varying degree of compression on the tubing when the pinching member is translated along the slot to modify the flow rate; and

a pinion coupled to a motor, wherein rotation of the pinion by the motor causes the linear motion of the rack.

34. The method of claim 33, wherein measuring the flow rate, generating the flow rate signal, receiving the flow rate signal, and comparing the flow rate with the desired flow rate are all carried out iteratively throughout a plurality of time increments such that, in each of the plurality of time increments, the flow rate is measured, the flow rate signal is generated, the flow rate signal is received, and the flow rate is compared with the desired flow rate;

wherein modifying the flow rate comprises moving the flow rate regulator from one of an open state that permits the liquid to flow through the intravenous delivery system, and a closed state that substantially prevents the liquid from flowing through the intravenous delivery system, to the other of the open state and the closed state;

wherein the method further comprises causing the flow rate regulator to remain in the other of the open state and the closed state for a predetermined number of the time increments.

35. The method of claim 33, wherein determining that the flow rate is different from the desired flow rate comprises determining that the flow rate differs from the desired flow rate by a differential flow rate;

wherein modifying the flow rate comprises moving the flow rate regulator in proportion to the differential flow rate to perform one of increasing the flow rate and decreasing the flow rate.

36. The method of claim 33, wherein the controller is incorporated into a computing device comprising a display screen and a user input device, the method further comprising:

via the user input device, and prior to comparing the flow rate with the desired flow rate, receiving the desired flow rate from a user; and

via the display screen and after generating the flow rate signal, initiating display of the flow rate.

37. A system for controlling flow of a liquid to a patient through use of an intravenous delivery system, the system comprising:

a flow rate sensor that:

measures a flow rate of the liquid through the intravenous delivery system; and

generates a flow rate signal indicative of the flow rate;

a controller that:

receives the flow rate signal;

compares the flow rate with a desired flow rate to determine that the flow rate is different from the desired flow rate; and

in response to determining that the flow rate is different from the desired flow rate, transmits a control signal; and

a flow rate regulator that:

receives the control signal; and

in response to receipt of the control signal, modifies the flow rate to bring the flow rate closer to the desired flow rate;

wherein the flow rate sensor, the controller, and the flow rate regulator all operate iteratively throughout a plurality of time increments such that, in each of the plurality of time increments, the flow rate sensor measures the flow rate and generates the flow rate signal, and the controller receives the flow rate signal and compares the flow rate with the desired flow rate;

wherein the controller determines that the flow rate is different from the desired flow rate by determining that the flow rate is less than the desired flow rate;

wherein, in response to receipt of the control signal, the flow rate regulator:

modifies the flow rate by moving from a closed state that substantially prevents the liquid from flowing through the intravenous delivery system, to a completely open state in that permits the liquid to flow through the intravenous delivery system; and

remains in the open state once a predetermined time increment has passed

wherein the weight sensor, the controller, and the flow rate regulator all operate iteratively throughout a plurality of time increments such that, in each of the plurality of time increments, the weight sensor measures the weight and generates the weight signal, and the controller receives the weight signal and compares the weight with the desired weight;

wherein the controller determines that the weight is different from the desired weight by determining that the weight is greater than the desired weight;

wherein, in response to receipt of the control signal, the weight regulator:

modifies the weight by moving from a completely open state that permits the liquid to flow through the intravenous delivery system, to a closed state that substantially prevents the liquid from flowing through the intravenous delivery system; and

remains in the closed state once sufficient the predetermined time increment has passed,

wherein the flow rate sensor measures the flow rate of the liquid through the system by:

measuring a first weight of the intravenous delivery system at a first time; and

measuring a second weight at a second time separated from the first time by a time increment;

wherein at least one of the flow rate sensor and the controller:

subtracts the second weight from the first weight to obtain a differential weight; and

obtains the flow rate based on the differential weight and the time increment.

38. The system of claim 37, wherein the controller is incorporated into a computing device comprising a display screen and a user input device, wherein the controller further:

receives the desired flow rate from a user via the user input device; and

initiates display of the flow rate on the display screen.

39. The system of claim 37, further comprising the intravenous delivery system, wherein the intravenous delivery system comprises:

a drip unit that receives the liquid from a liquid source via gravity feed;

tubing comprising:

a first end connectable to the drip unit to receive the liquid from the drip unit via gravity feed; and

a second end; and

an intravenous access unit connectable to the second end of the tubing, wherein the intravenous access unit is configured to receive the liquid from the second end via gravity feed and deliver the liquid intravenously to a patient.