[02] It would be desirable, therefore, to provide apparatus and methods for reducing the loss of medicament from the delivery pathway.

[03] Dispensers such as syringes are often prefilled with a desired medicament volume. A practitioner then fully depresses a plunger in the syringe to deliver the medicament into the patient. Prefilling the syringe reduces the likelihood of overfilling or underfilling by a practitioner. Fully depressing the plunger of the syringe reduces the likelihood of underdosing the patient, assuming that the prefilled volume is correct.

[04] Volumetric precision of prefilling a large volume may be greater than the volumetric precision of prefilling a small volume. When it is desirable to prefill the dispenser for the delivery of a small volume, the lack of volumetric precision may be unacceptable. It would be desirable, therefore, to provide apparatus and methods for using a dispenser to deliver a small volume of the medicament to the patient.

SUMMMARY OF INVENTION

[04a] A first aspect of the present invention provides a fitting for a fluid dispenser, the fitting having a longitudinal axis and comprising:

a detent that is configured to limit longitudinal insertion of the dispenser into the fitting by applying a longitudinal contact force against a terminal surface of the dispenser;

a seal that is configured to be deformed by the surface, into sealing contact against the surface, when the surface abuts the detent; and

a body that is configured to:

receive the surface; and

support the detent and the seal.

[04b] A second aspect of the present invention provides an apparatus for dispensing fluid, the apparatus comprising:

a coupler to sealingly engage a dispenser that is pre-filled with an initial volume of fluid; and

a body defining a passageway that is configured to be placed in fluid communication with the dispenser, the passageway:

having a volume that is not less than 10% the initial volume; and

being in fluid communication with a hypodermic needle.

[04c] A third aspect of the present invention provides a fluid dispenser, the dispenser having a longitudinal axis and a distal end, the distal end comprising:

a detent transverse to the longitudinal axis, the detent configured to limit longitudinal insertion of the dispenser into a fitting by applying a longitudinal contact force against a surface of the fitting;

a seal that is configured to be deformed by the surface, into sealing contact against the surface, when the detent abuts the surface; and

a terminal portion that is configured to:

support the detent and the seal; and

be received by the fitting.

BRIEF DESCRIPTION OF THE DRAWINGS

[05] FIG. 1 is a perspective view of apparatus in accordance with the principles of the invention;

[06] FIG. 2 is an exploded perspective view of the apparatus shown in FIG. 1, including a partial cross-sectional view of internal features of the apparatus;

[07] FIG. 3 is a partial cross-sectional view of the apparatus shown in FIG. 1, the view taken along lines 3-3 (shown in FIG. 1);

WHAT IS CLAIMED IS:

1. A fitting for a fluid dispenser, the fitting having a longitudinal axis and comprising:

a detent that is configured to limit longitudinal insertion of the dispenser into the fitting by applying a longitudinal contact force against a terminal surface of the dispenser;

a seal that is configured to be deformed by the surface, into sealing contact against the surface, when the surface abuts the detent; and

a body that is configured to:

receive the surface; and

support the detent and the seal.

2. The fitting of claim 1 wherein the detent defines an opening configured to be placed in fluid communication with the dispenser.

3. The fitting of claim 2 wherein:

the body includes an interior wall; and

the dispenser includes a lateral wall;

such that, when the surface is in sealing contact against the seal, and abuts the detent, the interior wall, the lateral wall and the seal define a region that is isolated from fluid communication with the dispenser.

4. The fitting of claim 3 wherein:

the region is a first dead space having a first volume;

the detent, when in contact with the surface, defines a second dead space having a second volume; and

the second volume is no more than 1% the first volume.

5. The fitting of claim 4 wherein the second dead space includes one or more volumes in a region that is:

transversely coextensive with contact between the surface and the detent; and

longitudinally extensive between the surface and the detent.

6. The fitting of claim 4 wherein the second dead space is within the seal.

7. The fitting of claim 3 wherein the sealing contact is sufficient to prevent leakage of fluid from the dispenser to the region when the dispenser is actuated to dispense the fluid.

8. The fitting of claim 2 wherein:

the dispenser is pre-filled with an initial volume of fluid; and

the body defines a void that is in fluid communication with the opening, the void having a void volume that is not less than 10% the initial volume.

9. The fitting of claim 8 wherein the void volume is selected from not less than 25%, 50%, 75% or 90% of the initial volume.

10. Apparatus for dispensing fluid, the apparatus comprising:

a coupler to sealingly engage a dispenser that is pre-filled with an initial volume of fluid; and

a body defining a passageway that is configured to be placed in fluid communication with the dispenser, the passageway:

having a volume that is not less than 10% the initial volume; and

being in fluid communication with a hypodermic needle.

11. The apparatus of claim 10 wherein the volume of the passageway is selected from not less than 25%, 50%, 75% or 90% of the initial volume.

12. The apparatus of claim 10 wherein a volume of fluid dispensed through an orifice of the needle is the initial volume reduced by an amount that is not less than the volume of the passageway.

13. A fluid dispenser, the dispenser having a longitudinal axis and a distal end, the distal end comprising:

a detent transverse to the longitudinal axis, the detent configured to limit longitudinal insertion of the dispenser into a fitting by applying a longitudinal contact force against a surface of the fitting;

a seal that is configured to be deformed by the surface, into sealing contact against the surface, when the detent abuts the surface; and

a terminal portion that is configured to:

support the detent and the seal; and

be received by the fitting.

14. The dispenser of claim 13 wherein the detent defines an aperture in fluid communication with a bore of the dispenser.

15. The dispenser of claim 14 wherein the fitting defines an opening configured to be placed in fluid communication with the aperture.

16. The dispenser of claim 15 wherein:

the terminal portion includes a lateral wall; and

the fitting includes an interior wall;

such that, when the seal is in sealing contact against the surface, and the detent abuts the surface, the lateral wall, the interior wall and the seal define a region that is isolated from fluid communication with the bore.

17. The dispenser of claim 16 wherein:the region is a first dead space having a first volume;

the detent, when in contact with the surface, defines a second dead space having a second volume; and

the second volume is no more than 1% the first volume.

18. The dispenser of claim 17 wherein the second dead space includes one or more volumes in a region that is:

transversely coextensive with contact between the surface and the detent; and

longitudinally extensive between the surface and the detent.

19. The dispenser of claim 17 wherein the second dead space is within the seal.

20. The dispenser of claim 16 wherein the sealing contact is sufficient to prevent leakage of fluid from the dispenser to the region when the dispenser is actuated to dispense the fluid.

21. The dispenser of claim 13 wherein the detent and the seal extend longitudinally in a distal direction from the terminal portion, the detent including a bottom, the seal, in a relaxed state, extending distally beyond the bottom.

22. The dispenser of claim 21 wherein the seal does not extend transversely under the bottom.

23. The dispenser of claim 22 wherein the terminal portion defines a recess configured to secure the seal such that a distal end of the seal is not drawn laterally under the bottom.

WHAT IS CLAIMED IS:

1. A fitting for a fluid dispenser, the fitting having a longitudinal axis and comprising:

a detent that is configured to limit longitudinal insertion of the dispenser into the fitting by applying a longitudinal contact force against a terminal surface of the dispenser;

a seal that is configured to be deformed by the surface, into sealing contact against the surface, when the surface abuts the detent; and

a body that is configured to:

receive the surface; and

support the detent and the seal.

2. The fitting of claim 1 wherein the detent defines an opening configured to be placed in fluid communication with the dispenser.

3. The fitting of claim 1 wherein the seal circumscribes the detent.

4. The fitting of claim 1 wherein the detent circumscribes the seal.

5. The fitting of claim 2 wherein:

the body includes an interior wall; and

the dispenser includes a lateral wall;

such that, when the surface is in sealing contact against the seal, and abuts the detent, the interior wall, the lateral wall and the seal define a region that is isolated from fluid communication with the dispenser.

6. The fitting of claim 5 wherein:

the region is a first dead space having a first volume;

the detent, when in contact with the surface, defines a second dead space having a second volume; and

the second volume is no more than 1% the first volume.

7. The fitting of claim 6 wherein the second dead space includes one or more volumes in a region that is:

transversely coextensive with contact between the surface and the detent; and

longitudinally extensive between the surface and the detent.

8. The fitting of claim 6 wherein the second dead space is within the seal.

9. The fitting of claim 5 wherein the sealing contact is sufficient to prevent leakage of fluid from the dispenser to the region when the dispenser is actuated to dispense the fluid.

10. The fitting of claim 2 wherein:

the dispenser is pre-filled with an initial volume of fluid; and

the body defines a void that is in fluid communication with the opening, the void having a void volume that is not less than 10% the initial volume.

11. The fitting of claim 10 wherein the void volume is not less than 25% the initial volume.

12. The fitting of claim 10 wherein the void volume is not less than 50% the initial volume.

13. The fitting of claim 10 wherein the void volume is not less than 75% the initial volume.

14. The fitting of claim 10 wherein the void volume is not less than 90% the initial volume.

15. The fitting of claim 10 wherein a volume of fluid dispensed through an orifice of a needle in fluid communication with the void is the initial volume reduced by an amount that is not less than the void volume.

16. The fitting of claim 1 wherein the seal is annular.

17. The fitting of claim 1 wherein:

the seal includes a proximal face; and

the seal includes a distal face, spaced apart from the proximal face.

18. The fitting of claim 17 wherein the proximal face and the distal face are substantially parallel.

19. The fitting of claim 17 wherein:

the seal includes an outer surface that extends in the longitudinal direction; and

the seal includes an inner surface that extends in the longitudinal direction.

20. The fitting of claim 19 wherein:

the distal face and the inner surface intersect at an angle of about 90°; and

the distal face and the outer surface intersect at an angle of about 90°.

21. The fitting of claim 1 further including a base portion from which the detent and the seal extend

longitudinally in a proximal direction, the detent including a top, the seal, in a relaxed state, extending proximally beyond the top.

22. The fitting of claim 21 wherein the seal does not extend transversely over the top.

23. The fitting of claim 22 wherein the base portion defines a recess configured to secure the seal such that a proximal end of the seal is not drawn laterally over the top.

24. The fitting of claim 1 wherein the surface, when the surface abuts the detent, lies athwart the axis.

25. The fitting of claim 1 wherein:

the detent has a first contour;

the surface has a second contour; and

the first contour and the second contour are complementary.

26. The fitting of claim 25 wherein:

the seal has a third contour; and

the second contour and the third contour are complementary.

27. The fitting of claim 1 wherein:

the seal comprises a first substance that has a first elastic modulus;

the detent comprises a second substance that has a second elastic modulus; and

the second elastic modulus is greater than the first elastic modulus.

28. The fitting of claim 27 wherein the surface is disposed on a portion of the dispenser having a third elastic modulus.

29. The fitting of claim 28 wherein the third elastic modulus is about the same as the second elastic modulus.

30. The fitting of claim 1 further comprising an engagement member that is configured to maintain the sealing contact by engaging the dispenser.

31. The fitting of claim 1 wherein the fitting is configured to engage a needle guard.

32. The fitting of claim 5 wherein the interior wall includes a boss that is configured to engage the lateral wall of the dispenser.

33. An insert for a fitting , the insert comprising a first material, the fitting comprising a second material, the first material being more compliant than the second material, the insert further comprising:

a distal gasket configured to seal against a terminal surface of a dispenser;

a proximal rim configured to:

engage a lateral wall of the dispenser; and

urge the gasket against the surface; and

a connector that is distally fixed to the gasket and proximally fixed to the rim.

34. The insert of claim 33 wherein the gasket is configured to be seated in a recess in the fitting.

35. The insert of claim 33 wherein the connector is configured to be seated in a recess in the fitting.

36. The insert of claim 33 wherein the rim is configured to conform to a flange of the fitting.

37. The insert of claim 33 wherein the connector transmits force between the gasket and the rim, thereby urging the gasket against the surface.

38. The insert of claim 33 wherein the connector transmits force between the gasket and the rim, thereby urging the rim against the lateral wall.

39. The insert of claim 33 wherein the insert is molded onto the fitting.

40. The insert of claim 33 wherein, when the gasket seals against the surface, a portion of the dispenser is coaxial with a portion of the fitting.

41. The insert of claim 40 wherein the rim applies force against the lateral wall, thereby maintaining the portion of the dispenser coaxial with the portion of the fitting.

42. The insert of claim 33 wherein:

the surface is disposed on a portion of the dispenser comprising a third material that is less compliant than the first material; and

the gasket is configured to be deformed between the surface and the fitting when the gasket is urged against the surface, thereby sealing the gasket against the surface.

43. Apparatus for dispensing fluid, the apparatus comprising:

a coupler to sealingly engage a dispenser that is pre-filled with an initial volume of fluid; and

a body defining a passageway that is configured to be placed in fluid communication with the dispenser, the passageway:

having a volume that is not less than 10% the initial volume; and

being in fluid communication with a hypodermic needle.

44. The apparatus of claim 43 wherein the volume of the passageway is not less than 25% the initial volume.

45. The apparatus of claim 43 wherein the volume of the passageway is not less than 50% the initial volume.

46. The apparatus of claim 43 wherein the volume of the passageway is not less than 75% the initial volume.

47. The apparatus of claim 43 wherein the volume of the passageway is not less than 90% the initial volume.

48. The apparatus of claim 43 wherein a volume of fluid dispensed through an orifice of the needle is the initial volume reduced by an amount that is not less than the volume of the passageway.

49. A method for dispensing a target volume of substance from a dispenser that is pre-filled with an initial volume of the substance, the method comprising:

discharging from the dispenser substantially all of the initial volume;

retaining, in a reservoir that is in fluid communication with the dispenser, a reservoir volume, wherein the reservoir volume is not less than 10% the initial volume; and

dispensing the target volume through an orifice of a needle that is in fluid communication with the reservoir, the target volume being the initial volume reduced by an amount that is not less than the reservoir volume.

50. The method of claim 49 wherein the reservoir volume is not less than 10% the initial volume.

51. The method of claim 49 wherein the reservoir volume is not less than 25% the initial volume.

52. The method of claim 49 wherein the reservoir volume is not less than 50% the initial volume.

53. The method of claim 49 wherein the reservoir volume is not less than 75% the initial volume.

54. The method of claim 49 wherein the reservoir volume is not less than 90% the initial volume.

55. The method of claim 49 wherein the discharging comprises translating a plunger within a bore of the dispenser, the bore having a bore bottom, from an initial position corresponding to the initial volume to a final position proximate the bore bottom.

56. A fluid dispenser, the dispenser having a longitudinal axis and a distal end, the distal end comprising:

a detent transverse to the longitudinal axis, the detent configured to limit longitudinal insertion of the dispenser into a fitting by applying a longitudinal contact force against a surface of the fitting;

a seal that is configured to be deformed by the surface, into sealing contact against the surface, when the detent abuts the surface; and

a terminal portion that is configured to:

support the detent and the seal; and

be received by the fitting.

57. The dispenser of claim 56 wherein the detent defines an aperture in fluid communication with a bore of the dispenser.

58. The dispenser of claim 57 wherein the fitting defines an opening configured to be placed in fluid communication with the aperture.

59. The dispenser of claim 56 wherein the seal circumscribes the detent.

60. The dispenser of claim 56 wherein the detent circumscribes the seal.

61. The dispenser of claim 58 wherein:

the terminal portion includes a lateral wall; and

the fitting includes an interior wall;

such that, when the seal is in sealing contact against the surface, and the detent abuts the surface, the lateral wall, the interior wall and the seal define a region that is isolated from fluid communication with the bore.

62. The dispenser of claim 61 wherein:

the region is a first dead space having a first volume;

the detent, when in contact with the surface, defines a second dead space having a second volume; and

the second volume is no more than 1% the first volume.

63. The dispenser of claim 62 wherein the second dead space includes one or more volumes in a region that is:

transversely coextensive with contact between the surface and the detent; and

longitudinally extensive between the surface and the detent.

64. The dispenser of claim 62 wherein the second dead space is within the seal.

65. The dispenser of claim 61 wherein the sealing contact is sufficient to prevent leakage of fluid from the dispenser to the region when the dispenser is actuated to dispense the fluid.

66. The dispenser of claim 56 wherein the seal is annular.

67. The dispenser of claim 56 wherein the detent and the seal extend longitudinally in a distal direction from the terminal portion, the detent including a bottom, the seal, in a relaxed state, extending distally beyond the bottom.

68. The dispenser of claim 67 wherein the seal does not extend transversely under the bottom.

69. The dispenser of claim 68 wherein the terminal portion defines a recess configured to secure the seal such that a distal end of the seal is not drawn laterally under the bottom.

70. The dispenser of claim 56 wherein the surface, when the detent abuts the surface, lies athwart the axis.

71. The dispenser of claim 56 wherein:

the detent has a first contour;

the surface has a second contour; and

the first contour and the second contour are complementary.

72. The dispenser of claim 71 wherein:

the seal has a third contour; and

the second contour and the third contour are complementary.

73. The dispenser of claim 56 wherein:

the seal comprises a first substance that has a first elastic modulus;

the detent comprises a second substance that has a second elastic modulus; and

the second elastic modulus is greater than the first elastic modulus.

74. The dispenser of claim 73 wherein the surface is disposed on a portion of the fitting having a third elastic modulus.

75. The dispenser of claim 74 wherein the third elastic modulus is about the same as the second elastic modulus.

76. The dispenser of claim 56 further comprising an engagement member that is configured to maintain the sealing contact by engaging the fitting.

77. The dispenser of claim 56 wherein the dispenser comprises a glass syringe.