Claims

1. A tubing kit for forming a mixture comprising:

   a first portion of tubing configured to be fluidly connected to a container containing a first composition;

   a second portion of tubing configured to be fluidly connected to a container containing a second composition;

   a dampener fluidly connected to the first portion of tubing and fluidly connected to the second portion of tubing;

   a mixer for mixing the first composition from the first portion of tubing and the second composition from the second portion of tubing;

   a mixture container for collecting the mixed first composition and second composition from the mixer,

   wherein the first portion of tubing is configured to be connected to at least one peristaltic pump head for pumping the first composition from the container containing the first composition to the mixture container, and the second portion of tubing is configured to be connected to at least one peristaltic pump head for pumping the second composition from the container containing the second composition to the mixture container.

2. The tubing kit of claim 1, wherein the dampener comprises an enclosed volume of fluid.

3. The tubing kit of claim 2, wherein the fluid is air.

4. The tubing kit of any of claims 1-3, wherein the dampener is a tubing dampener.

5. The tubing kit of claim 1, wherein the dampener comprises a flexible membrane.

6. The tubing kit of any of claims 1-5, further comprising a first tee connector that fluidly connects the dampener, the first portion of tubing, and a first mixer input portion of tubing, wherein the first mixer input portion of tubing fluidly connects to the mixer.

7. The tubing kit of claim 6, further comprising a second tee connector that fluidly connects the dampener, the second portion of tubing, and a second mixer input portion of tubing, wherein the second mixer input portion of tubing fluidly connects to the mixer.

8. The tubing kit of any of claims 1-7, wherein the first portion of tubing comprises a first segment of tubing and a second segment of tubing, wherein the first segment of tubing and the second segment of tubing are fluidly connected in parallel.

9. The tubing kit of claim 8, wherein the first segment of tubing is configured to be connected to a first peristaltic pump head, and the second segment of tubing is configured to be connected to a second peristaltic pump head.

10. The tubing kit of any of claims 1-8, wherein the second portion of tubing comprises a third segment of tubing and a fourth segment of tubing, wherein the third portion of tubing and the fourth portion of tubing are fluidly connected in parallel.

11. The tubing kit of claim 10, wherein the third segment of tubing is configured to be connected to a third peristaltic pump head, and the fourth segment of tubing is configured to be connected to a fourth peristaltic pump head.

12. The tubing kit of any of claims 1-11, wherein the mixer comprises an input fluidly connected to the first portion of tubing, an input fluidly connected to the second portion of tubing, and output fluidly connected to the mixture container.

13. The tubing kit of any of claims 1-12, wherein the mixer comprises a Y-connector, a helical mixer, or a static mixer.

14. The tubing kit of any of claims 1-13, further comprising a first dampener connector that fluidly connects the first portion of tubing to the dampener and to the mixer and a second dampener connector that fluidly connects the second portion of the tubing to the dampener and to the mixer.

15. The tubing kit of any of claims 1-14, wherein the mixture container is a bag, vessel, or bottle.

16. A system for forming a pharmaceutical composition or mixture of pharmaceutical compositions, the system comprising:

    a first container containing a first pharmaceutical composition;

    a second container containing a second pharmaceutical composition;

    a first portion of tubing fluidly connected to the first container;

    a second portion of tubing fluidly connected to the second container;

a dampener fluidly connected to the first portion of tubing and fluidly connected to the second portion of tubing;

a mixer for mixing the first pharmaceutical composition from the first portion of tubing and the second pharmaceutical composition from the second portion of tubing; and

a mixture container for collecting the mixed first pharmaceutical composition and second pharmaceutical composition from the mixer.

17. The system of claim 16, further comprising at least one peristaltic pump head connected to the first portion of tubing for pumping the first composition from the container containing the first composition to the mixture container, and at least one peristaltic pump connected to the second portion of tubing for pumping the second composition from the container containing the first composition to the mixture container.

~~18. The system of any one of claims 16-17, wherein the first composition or second composition comprises a nucleic acid, one or more lipids, one or more proteins, or a buffer.~~

~~19. The system of any one of claims 16-18, wherein the first composition comprises a nucleic acid and the second composition comprises one or more lipids.~~

~~20. The system of claim 18, wherein the first composition comprises RNA and the second composition comprises one or more lipids.~~

~~21. The system of claim 20, wherein the RNA comprises one or more polynucleotides encoding 10-20 neoepitopes resulting from cancer-specific somatic mutations present in a tumor specimen.~~

~~22. The system of claim 21, wherein the RNA is formulated in a lipoplex nanoparticle or liposome.~~

~~23. The system of claim 22, wherein the lipoplex nanoparticle or liposome comprises one or more lipids that form a multilamellar structure that encapsulates the RNA.~~

~~24. The system of claim 20, wherein the one or more lipids comprises at least one cationic lipid and at least one helper lipid.~~

25. The system of claim 20, wherein the one or more lipids comprises (R)-N,N,N-trimethyl-2,3-dioleyloxy-1-propanaminium chloride (DOTMA) and 1,2-dioleoyl-sn-glycero-3-phosphoethanolamine (DOPE).

26. The system of claim 25, wherein at physiological pH the overall charge ratio of positive charges to negative charges of the liposome is 1.3:2 (0.65).

27. The system of any one of claims 20-26, wherein the RNA comprises an RNA molecule comprising, in the 5'→3' direction:

(1) a 5' cap;

(2) a 5' untranslated region (UTR);

(3) a polynucleotide sequence encoding a secretory signal peptide;

(4) a polynucleotide sequence encoding the one or more neoepitopes resulting from cancer-specific somatic mutations present in a tumor specimen;

(5) a polynucleotide sequence encoding at least a portion of a transmembrane and cytoplasmic domain of a major histocompatibility complex (MHC) molecule;

(6) a 3' UTR comprising:

(a) a 3' untranslated region of an Amino-Terminal Enhancer of Split (AES) mRNA or a fragment thereof; and

(b) non-coding RNA of a mitochondrially encoded 12S RNA or a fragment thereof; and

(7) a poly(A) sequence.

28. The system of claim 27, wherein the RNA molecule further comprises a polynucleotide sequence encoding an amino acid linker; wherein the polynucleotide sequences encoding the amino acid linker and a first of the one or more neoepitopes form a first linker-neoepitope module; and wherein the polynucleotide sequences forming the first linker-neoepitope module are between the polynucleotide sequence encoding the secretory signal peptide and the polynucleotide sequence encoding the at

least portion of the transmembrane and cytoplasmic domain of the MHC molecule in the 5'→3' direction.

29. The system of claim 28, wherein the amino acid linker comprises the sequence GGSGGGGSGG (SEQ ID NO:21).

30. The system of claim 28, wherein the polynucleotide sequence encoding the amino acid linker comprises the sequence GGCGGCUCUGGAGGAGGCGGCUCCGGAGGC (SEQ ID NO:19).

31. The system of any one of claims 28-30, wherein the RNA molecule further comprises, in the 5'→3' direction: at least a second linker-epitope module, wherein the at least second linker-epitope module comprises a polynucleotide sequence encoding an amino acid linker and a polynucleotide sequence encoding a neoepitope; wherein the polynucleotide sequences forming the second linker-neoepitope module are between the polynucleotide sequence encoding the neoepitope of the first linker-neoepitope module and the polynucleotide sequence encoding the at least portion of the transmembrane and cytoplasmic domain of the MHC molecule in the 5'→3' direction; and wherein the neoepitope of the first linker-epitope module is different from the neoepitope of the second linker-epitope module.

32. The system of claim 31, wherein the RNA molecule comprises 5 linker-epitope modules, and wherein the 5 linker-epitope modules each encode a different neoepitope.

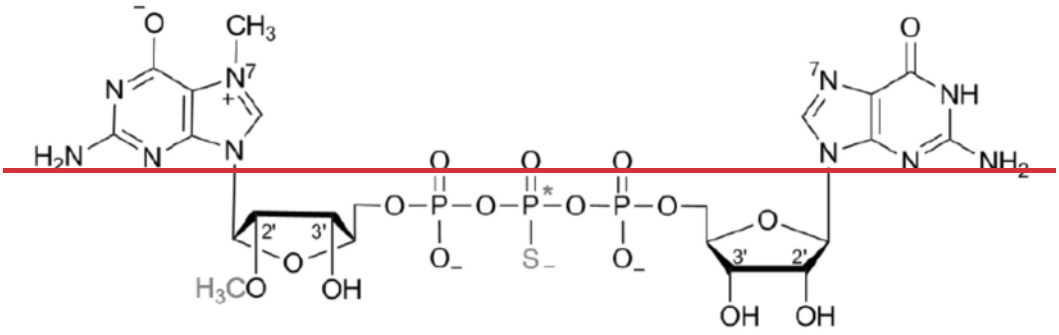
33. The system of claim 31, wherein the RNA molecule comprises 10 linker-epitope modules, and wherein the 10 linker-epitope modules each encode a different neoepitope.

34. The system of claim 31, wherein the RNA molecule comprises 20 linker-epitope modules, and wherein the 20 linker-epitope modules each encode a different neoepitope.

35. The system of any one of claims 28-34, wherein the RNA molecule further comprises a second polynucleotide sequence encoding an amino acid linker, wherein the second polynucleotide sequence encoding the amino acid linker is between the

polynucleotide sequence encoding the neoepitope that is most distal in the 3’ direction and the polynucleotide sequence encoding the at least portion of the transmembrane and cytoplasmic domain of the MHC molecule.

36. The system of any one of claims 28-35, wherein the 5’ cap comprises a D1 diastereoisomer of the structure:



37. The system of any one of claims 28-36, wherein the 5’ UTR comprises the sequence UUCUUCUGGUCCCCACAGACUCAGAGAGAACCCGCCACC (SEQ ID NO:5).

38. The system of any one of claims 28-37, wherein the 5’ UTR comprises the sequence GGCGAACUAGUAUUCUUCUGGUCCCCACAGACUCAGAGAGAACCCGCCACC (SEQ ID NO:3).

39. The system of any one of claims 28-38, wherein the secretory signal peptide comprises the amino acid sequence MRVMAPRTLILLLSGALALTETWAGS (SEQ ID NO:9).

40. The system of any one of claims 28-38, wherein the polynucleotide sequence encoding the secretory signal peptide comprises the sequence AUGAGAGUGAUGGCCCCCAGAACCCUGAUCCUGCUGCUGUCUGGCGCCCUGGCCCUGACAGAGACAUGGGCCCGGAAGC (SEQ ID NO:7).

41. The system of any one of claims 28-40, wherein the at least portion of the transmembrane and cytoplasmic domain of the MHC molecule comprises the amino acid sequence IVGIVAGLAVLAVVVIGAVVATVMCRRKSSGGKGGSYSQAASSDSAQGSDVSLTA (SEQ ID NO:12).

42. The system of any one of claims 28-40, wherein the polynucleotide sequence encoding the at least portion of the transmembrane and cytoplasmic domain of the MHC molecule comprises the sequence AUCGUGGGAAUUGUGGCAGGACUGGCAGUGCUGGCCGUGGUGGUGAUC GGAGCCGUGGUGGCUACCGUGAUGUGCAGACGGAAGUCCAGCGGAGGC AAGGGCGGCAGCUACAGCCAGGCCGCCAGCUCUGAUAGCGCCCAGGGCA GCGACGUGUCACUGACAGCC (SEQ ID NO:10).

43. The system of any one of claims 28-42, wherein the 3' untranslated region of the AES mRNA comprises the sequence CUGGUACUGCAUGCACGCAAUGCUAGCUGCCCCUUUCCCGUCCUGGGUA CCCCGAGUCUCCCCCGACCUCGGGUCCCAGGUAUGCUCCCACCUCCACC UGCCCCACUCACCACCUCUGCUAGUUCCAGACACCUCC (SEQ ID NO:15).

44. The system of any one of claims 28-43, wherein the non-coding RNA of the mitochondrially encoded 12S RNA comprises the sequence CAAGCACGCAGCAAUGCAGCUCAAAACGCUUAGCCUAGCCACACCCCCA CGGGAAACAGCAGUGAUUAACCUUUAGCAAUAAACGAAAGUUUAACUA AGCUAUACUAACCCCAGGGUUGGUCAAUUUCGUGCCAGCCACACCG (SEQ ID NO:17).

45. The system of any one of claims 28-44, wherein the 3' UTR comprises the sequence CUCGAGCUGGUACUGCAUGCACGCAAUGCUAGCUGCCCCUUUCCCGUCC UGGGUACCCCGAGUCUCCCCCGACCUCGGGUCCCAGGUAUGCUCCCACC UCCACCUGCCCCACUCACCACCUCUGCUAGUUCCAGACACCUCCCAAGC ACGCAGCAAUGCAGCUCAAAACGCUUAGCCUAGCCACACCCCCACGGGA AACAGCAGUGAUUAACCUUUAGCAAUAAACGAAAGUUUAACUAAGCUA UACUAACCCCAGGGUUGGUCAAUUUCGUGCCAGCCACACCGAGACCUGG UCCAGAGUCGCUAGCCGCGUCGCU (SEQ ID NO:13).

46. The system of any one of claims 28-45, wherein the poly(A) sequence comprises 120 adenine nucleotides.

47. The system of claim 20, wherein the RNA comprises an RNA molecule comprising, in the 5'→3' direction:

~~the polynucleotide sequence GGCGAACUAGUAUUCUUCUGGUCCCCACAGACUCAGAGAGAACCCGCCACCAU GAGAGUGAUGGCCCCCAGAACCCUGAUCCUGCUGCUGUCUGGCGCCCUGGCCC UGACAGAGACAUGGGCCGGAAGC (SEQ ID NO:1);~~

~~a polynucleotide sequence encoding the one or more neoepitopes resulting from cancer-specific somatic mutations present in the tumor specimen; and~~

~~the polynucleotide sequence AUCGUGGGAAUUGUGGCAGGACUGGCAGUGCUGGCCGUGGUGGUGAUCGGAG CCGUGGUGGCUACCGUGAUGUGCAGACGGAAGUCCAGCGGAGGCAAGGGCGGC AGCUACAGCCAGGCCGCCAGCUCUGAUAGCGCCCAGGGCAGCGACGUGUCACU GACAGCCUAGUAACUCGAGCUGGUACUGCAUGCACGGCAAUGCUAGCUGCCCCU UUCCCGUCCUGGGUACCCCGAGUCUCCCCCGACCUCGGGUCCCAGGUAUGCUC CCACCUCCACCUGCCCCACUCACCACCUCUGCUAGUUCCAGACACCUCCCAAGC ACGCAGCAAUGCAGCUCAAAACGCUUAGCCUAGCCACACCCCCACGGGAAACA GCAGUGAUUAACCUUUAGCAAUAAACGAAAGUUUAACUAAGCUAUACUAACC CCAGGGUUGGUCAAUUUCGUGCCAGCCACACCGAGACCUGGUCCAGAGUCGCU AGCCGCGUCGCU (SEQ ID NO:2).~~

~~48.~~18. A method for transferring pharmaceutical compositions using peristaltic pumps comprising:

pumping a first composition from a first container through a first portion of tubing using at least one peristaltic pump;

pumping a second composition from a second container through a second portion of tubing using at least one peristaltic pump; and

dampening pulse in a fluid flow of the first composition in the first portion of tubing and dampening pulses in a fluid flow of the second composition in the second portion of tubing using a dampener fluid connected to the first portion of tubing and fluidly connected to the second portion of tubing.

~~49.~~19. The method of claim 18~~48~~, further comprising mixing the first composition from the first portion of tubing and the second composition from the second portion of tubing in a mixer fluidly connected to the first portion of tubing and the second portion of tubing.

~~50.~~20. The method of claim 19~~49~~, further comprising depositing the mixture containing the first composition and the second composition into a mixture container that is fluidly connected to the mixture.

~~51. The method of any one of claims 48-50, wherein the first composition or second composition comprises a nucleic acid, one or more lipids, one or more proteins, or a buffer.~~

~~52. The method of any one of claims 48-51, wherein the first composition comprises a nucleic acid and the second composition comprises one or more lipids.~~

~~53. The method of claim 52, wherein the first composition comprises RNA and the second composition comprises one or more lipids.~~

~~54. The method of claim 53, wherein the RNA comprises one or more polynucleotides encoding 10-20 neoepitopes resulting from cancer-specific somatic mutations present in a tumor specimen.~~

~~55. The method of claim 54, wherein the RNA is formulated in a lipoplex nanoparticle or liposome.~~

~~56. The method of claim 55, wherein the lipoplex nanoparticle or liposome comprises one or more lipids that form a multilamellar structure that encapsulates the RNA.~~

~~57. The method of claim 53, wherein the one or more lipids comprises at least one cationic lipid and at least one helper lipid.~~

~~58. The method of claim 53, wherein the one or more lipids comprises (R)-N,N,N-trimethyl-2,3-dioleyloxy-1-propanaminium chloride (DOTMA) and 1,2-dioleoyl-sn-glycero-3-phosphoethanolamine (DOPE).~~

~~59. The method of claim 58, wherein at physiological pH the overall charge ratio of positive charges to negative charges of the liposome is 1.3:2 (0.65).~~

~~60. The method of any one of claims 53-59, wherein the RNA comprises an RNA molecule comprising, in the 5'→3' direction:~~

~~(1) a 5' cap;~~

(2) a 5’ untranslated region (UTR);

(3) a polynucleotide sequence encoding a secretory signal peptide;

(4) a polynucleotide sequence encoding the one or more neoepitopes resulting from cancer-specific somatic mutations present in a tumor specimen;

(5) a polynucleotide sequence encoding at least a portion of a transmembrane and cytoplasmic domain of a major histocompatibility complex (MHC) molecule;

(6) a 3’ UTR comprising:

(a) a 3’ untranslated region of an Amino-Terminal Enhancer of Split (AES) mRNA or a fragment thereof; and

(b) non-coding RNA of a mitochondrially encoded 12S RNA or a fragment thereof; and

(7) a poly(A) sequence.

61. The method of claim 60, wherein the RNA molecule further comprises a polynucleotide sequence encoding an amino acid linker; wherein the polynucleotide sequences encoding the amino acid linker and a first of the one or more neoepitopes form a first linker-neoepitope module; and wherein the polynucleotide sequences forming the first linker-neoepitope module are between the polynucleotide sequence encoding the secretory signal peptide and the polynucleotide sequence encoding the at least portion of the transmembrane and cytoplasmic domain of the MHC molecule in the 5’→3’ direction.

62. The method of claim 61, wherein the amino acid linker comprises the sequence GGSGGGGSGG (SEQ ID NO:21).

63. The method of claim 62, wherein the polynucleotide sequence encoding the amino acid linker comprises the sequence GGCGGCUCUGGAGGAGGCGGCUCCGGAGGC (SEQ ID NO:19).

64. The method of any one of claims 61-63, wherein the RNA molecule further comprises, in the 5’→3’ direction: at least a second linker-epitope module, wherein

the at least second linker-epitope module comprises a polynucleotide sequence encoding an amino acid linker and a polynucleotide sequence encoding a neoepitope; wherein the polynucleotide sequences forming the second linker-neoepitope module are between the polynucleotide sequence encoding the neoepitope of the first linker-neoepitope module and the polynucleotide sequence encoding the at least portion of the transmembrane and cytoplasmic domain of the MHC molecule in the 5'→3' direction; and wherein the neoepitope of the first linker-epitope module is different from the neoepitope of the second linker-epitope module.

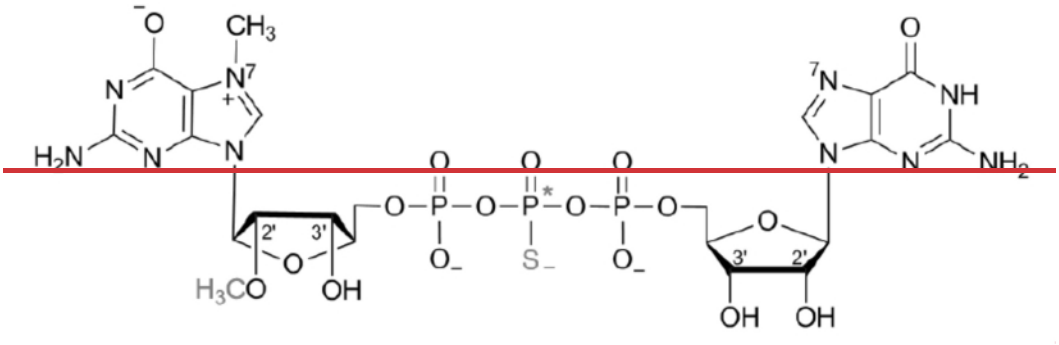
65. The method of claim 64, wherein the RNA molecule comprises 5 linker-epitope modules, and wherein the 5 linker-epitope modules each encode a different neoepitope.

66. The method of claim 64, wherein the RNA molecule comprises 10 linker-epitope modules, and wherein the 10 linker-epitope modules each encode a different neoepitope.

67. The method of claim 66, wherein the RNA molecule comprises 20 linker-epitope modules, and wherein the 20 linker-epitope modules each encode a different neoepitope.

68. The method of any one of claims 61-67, wherein the RNA molecule further comprises a second polynucleotide sequence encoding an amino acid linker, wherein the second polynucleotide sequence encoding the amino acid linker is between the polynucleotide sequence encoding the neoepitope that is most distal in the 3' direction and the polynucleotide sequence encoding the at least portion of the transmembrane and cytoplasmic domain of the MHC molecule.

69. The method of any one of claims 61-68, wherein the 5' cap comprises a D1 diastereoisomer of the structure:



70. The method of any one of claims 61-69, wherein the 5’ UTR comprises the sequence UUCUUCUGGUCCCCACAGACUCAGAGAGAACCCGCCACC (SEQ ID NO:5).

71. The method of any one of claims 61-70, wherein the 5’ UTR comprises the sequence GGCGAACUAGUAUUCUUCUGGUCCCCACAGACUCAGAGAGAACCCGCCACC (SEQ ID NO:3).

72. The method of any one of claims 61-71, wherein the secretory signal peptide comprises the amino acid sequence MRVMAPRTLILLLSGALALTETWAGS (SEQ ID NO:9).

73. The method of any one of claims 61-71, wherein the polynucleotide sequence encoding the secretory signal peptide comprises the sequence AUGAGAGUGAUGGCCCCCAGAACCCUGAUCCUGCUGCUGUCUGGCGCCCUGGCCCUGACAGAGACAUGGGCCGGAAGC (SEQ ID NO:7).

74. The method of any one of claims 61-73, wherein the at least portion of the transmembrane and cytoplasmic domain of the MHC molecule comprises the amino acid sequence IVGIVAGLAVLAVVVIGAVVATVMCRRKSSGGKGGSYSQAASSDSAQGSDVSLTA (SEQ ID NO:12).

75. The method of any one of claims 61-73, wherein the polynucleotide sequence encoding the at least portion of the transmembrane and cytoplasmic domain of the MHC molecule comprises the sequence AUCGUGGGAAUUGUGGCAGGACUGGCAGUGCUGGCCGUGGUGGUGAUCGGAGCCGUGGUGGCUACCGUGAUGUGCAGACGGAAGUCCAGCGGAGGC

AAGGGCGGCAGCUACAGCCAGGCCGCCAGCUCUGAUAGCGCCCAGGGCAGCGACGUGUCACUGACAGCC (SEQ ID NO:10).

76. The method of any one of claims 61-75, wherein the 3' untranslated region of the AES mRNA comprises the sequence CUGGUACUGCAUGCACGCAAUGCUAGCUGCCCCUUUCCCGUCCUGGGUACCCCGAGUCUCCCCCGACCUCGGGUCCCAGGUAUGCUCCCACCUCCACCUGCCCCACUCACCACCUCUGCUAGUUCCAGACACCUCC (SEQ ID NO:15).

77. The method of any one of claims 61-76, wherein the non-coding RNA of the mitochondrially encoded 12S RNA comprises the sequence CAAGCACGCAGCAAUGCAGCUCAAAACGCUUAGCCUAGCCACACCCCCACGGGAAACAGCAGUGAUUAACCUUUAGCAAUAAACGAAAGUUUAACUAAGCUAUACUAACCCCAGGGUUGGUCAAUUUCGUGCCAGCCACACCG (SEQ ID NO:17).

78. The method of any one of claims 61-77, wherein the 3' UTR comprises the sequence CUCGAGCUGGUACUGCAUGCACGCAAUGCUAGCUGCCCCUUUCCCGUCCUGGGUACCCCGAGUCUCCCCCGACCUCGGGUCCCAGGUAUGCUCCCACCUCCACCUGCCCCACUCACCACCUCUGCUAGUUCCAGACACCUCCCAAGCACGCAGCAAUGCAGCUCAAAACGCUUAGCCUAGCCACACCCCCACGGGAAACAGCAGUGAUUAACCUUUAGCAAUAAACGAAAGUUUAACUAAGCUAUACUAACCCCAGGGUUGGUCAAUUUCGUGCCAGCCACACCGAGACCUGGUCCAGAGUCGCUAGCCGCGUCGCU (SEQ ID NO:13).

79. The method of any one of claims 61-78, wherein the poly(A) sequence comprises 120 adenine nucleotides.

80. The method of claim 53, wherein the RNA comprises an RNA molecule comprising, in the 5'→3' direction:

the polynucleotide sequence GGCGAACUAGUAUUCUUCUGGUCCCCACAGACUCAGAGAGAACCCGCCACCAUGAGAGUGAUGGCCCCCAGAACCCUGAUCCUGCUGCUGUCUGGCGCCCUGGCCCUGACAGAGACAUGGGCCCGGAAGC (SEQ ID NO:1);

a polynucleotide sequence encoding the one or more neoepitopes resulting from cancer-specific somatic mutations present in the tumor specimen; and

the polynucleotide sequence AUCGUGGGAAUUGUGGCAGGACUGGCAGUGCUGGCCGUGGUGGUGAUCGGAG CCGUGGUGGCUACCGUGAUGUGCAGACGGAAGUCCAGCGGAGGCAAGGGCGGC AGCUACAGCCAGGCCGCCAGCUCUGAUAGCGCCCAGGGCAGCGACGUGUCACU GACAGCCUAGUAACUCGAGCUGGUACUGCAUGCACGCAAUGCUAGCUGCCCCU UUCCCGUCCUGGGUACCCCGAGUCUCCCCCGACCUCGGGUCCCAGGUAUGCUC CCACCUCCACCUGCCCCACUCACCACCUCUGCUAGUUCCAGACACCUCCCAAGC ACGCAGCAAUGCAGCUCAAAACGCUUAGCCUAGCCACACCCCCACGGGAAACA GCAGUGAUUAACCUUUAGCAAUAAACGAAAGUUUAACUAAGCUAUACUAACC CCAGGGUUGGUCAAUUUCGUGCCAGCCACACCGAGACCUGGUCCAGAGUCGCU AGCCGCGUCGCU (SEQ ID NO:2).

81. A method for transferring pharmaceutical compositions using peristaltic pumps comprising:

pumping a first composition from a first container through a first portion of tubing using at least one peristaltic pump head at a first flow rate;

pumping a second composition from a second container through a second portion of tubing using at least one peristaltic pump at a second flow rate; and

dampening pulses in a fluid flow of the first composition in the first portion of tubing and dampening pulses in a fluid flow of the second composition in the second portion of tubing using a dampener fluidly connected to the first portion of tubing and fluidly connected to the second portion of tubing, wherein the level of pulsation (LoP) of the flow rate of the first flow rate in the first portion of tubing after the dampener is less than 10 and the level of pulsation (LoP) of the flow rate of the second flow rate in the second portion of tubing after the dampener is less than 10.

82. A method for manufacturing a pharmaceutical composition comprising a nucleic acid and one or more lipids comprising:

pumping a first composition comprising a nucleic acid from a first container through a first portion of tubing using at least one peristaltic pump head at a first flow rate;

pumping a second composition comprising one or more lipids from a second container through a second portion of tubing using at least one peristaltic pump head at a second flow rate;

dampening pulses in a fluid flow of the first composition in the first portion of tubing and dampening pulses in a fluid flow of the second composition in the second portion of tubing using a dampener fluidly connected to the first portion of tubing and fluidly connected to the second portion of tubing;

mixing the first composition comprising the nucleic acid from the first portion of tubing and the second composition comprising the one or more lipids from the second portion of tubing in a mixer fluidly connected to the first portion of tubing and the second portion of tubing; and

depositing a composition comprising the nucleic acid and the one or more lipids into a container that is fluidly connected to the mixture.

83. The tubing kit, system, or method of any one of claims 1-82, wherein the first portion of tubing and the second portion of tubing are configured to be connected to pump heads of the same peristaltic pump.

84. The tubing kit, system, or method of any one of claims 1-83, wherein the first portion of tubing, the second portion of tubing, the dampener, the mixer, and/or the mixture container are made up of single-use materials.

85. The tubing kit, system, or method of any one of claims 1-84, further comprising the tubing kit or system is an aespetic, closed tubing kit or system; or the methods are performed in an aespetic, closed system.

86. A tubing kit for forming a mixture comprising:

a first portion of tubing configured to be fluidly connected to a first container containing a first composition;

a second portion of tubing configured to be fluidly connected to a second container containing a second composition;

a tubing dampener comprising an enclosed volume of fluid fluidly connected to the first portion of tubing and the second portion of tubing;

a mixer fluidly connected to the first portion of tubing and the second portion of tubing downstream from the fluid dampener and configured to mix the first

composition from the first portion of tubing and the second composition from the second portion of tubing;

a mixture container fluidly connected to the mixer and configured to collect the mixed first composition and second composition from the mixer,

wherein the first portion of tubing is configured to be connected to a first peristaltic pump head upstream the tubing dampener for pumping the first composition from the first container to the mixture container, and the second portion of tubing is configured to be connected to a second peristaltic pump head upstream the tubing dampener for pumping the second composition from the second container to the mixture container.

87. A system for forming a pharmaceutical composition or mixture of pharmaceutical compositions, the system comprising:

a first container containing a first pharmaceutical composition;

a second container containing a second pharmaceutical composition;

a first portion of tubing fluidly connected to the first container;

a second portion of tubing fluidly connected to the second container;

a peristaltic pump comprising a first peristaltic pump head connected to the first portion of tubing for pumping the first pharmaceutical composition from the first container and a second peristaltic pump head connected to the second portion of tubing for pumping the second pharmaceutical composition from the second container;

a tubing dampener comprising an enclosed volume of fluid fluidly connected to the first portion of tubing and the second portion of tubing downstream from the peristaltic pump;

a mixer fluidly connected to the first portion of tubing and the second portion of tubing downstream from the fluid dampener and configured to mix the first pharmaceutical composition from the first portion of tubing and the second pharmaceutical composition from the second portion of tubing; and

a mixture container fluidly connected to the mixer and configured to collect the mixed first pharmaceutical composition and second pharmaceutical composition from the mixer.

88. A method for transferring pharmaceutical compositions using peristaltic pumps comprising:

pumping a first composition from a first container through a first portion of tubing using a first peristaltic pump head;

pumping a second composition from a second container through a second portion of tubing using a second peristaltic pump head; and

dampening pulse in a fluid flow of the first composition in the first portion of tubing downstream the first peristaltic pump head and dampening pulses in a fluid flow of the second composition in the second portion of tubing downstream the second peristaltic pump head using a tubing dampener comprising an enclosed volume of fluid fluidly connected to the first portion of tubing and the second portion of tubing;

mixing the first composition from the first portion of tubing and the second composition from the second portion of tubing in a mixer fluidly connected to the first portion of tubing and the second portion of tubing downstream from the fluid dampener; and

depositing a composition comprising mixed first and second composition into a container that is fluidly connected to the mixer.

89. A tubing kit for forming a mixture comprising:

a first portion of tubing configured to be fluidly connected to a container containing a first composition;

a second portion of tubing configured to be fluidly connected to a container containing a second composition;

a first dampener fluidly connected to the first portion of tubing;

a second dampener fluidly connected to the second portion of tubing;

a mixer for mixing the first composition from the first portion of tubing and the second composition from the second portion of tubing;

a mixture container for collecting the mixed first composition and second composition from the mixer,

wherein the first portion of tubing is configured to be connected to at least one peristaltic pump head for pumping the first composition from the container containing the first composition to the mixture container, and the second portion of tubing is configured to be connected to at least one peristaltic pump head for pumping the second composition from the container containing the second composition to the mixture container.

~~90. The tubing kit of claim 89, wherein the first and/or second dampener comprises an enclosed volume of fluid.~~

~~91. The tubing kit of claim 90, wherein the fluid is air.~~

~~92. The tubing kit of any of claims 89-91, wherein the first and/or second dampener is a tubing dampener.~~

~~93. The tubing kit of claim 89, wherein the dampener comprises a flexible membrane.~~

~~94. The tubing kit of any of claims 89-93, further comprising a first tee connector that fluidly connects the first dampener, the first portion of tubing, and a first mixer input portion of tubing, wherein the first mixer input portion of tubing fluidly connects to the mixer.~~

~~95. The tubing kit of claim 94, further comprising a second tee connector that fluidly connects the second dampener, the second portion of tubing, and a second mixer input portion of tubing, wherein the second mixer input portion of tubing fluidly connects to the mixer.~~

~~96. The tubing kit of any of claims 89-95, wherein the first portion of tubing comprises a first segment of tubing and a second segment of tubing, wherein the first segment of tubing and the second segment of tubing are fluidly connected in parallel.~~

~~97. The tubing kit of claim 96, wherein the first segment of tubing is configured to be connected to a first peristaltic pump head, and the second segment of tubing is configured to be connected to a second peristaltic pump head.~~

~~98. The tubing kit of any of claims 89-97, wherein the second portion of tubing comprises a third segment of tubing and a fourth segment of tubing, wherein the third portion of tubing and the fourth portion of tubing are fluidly connected in parallel.~~

~~99. The tubing kit of claim 98, wherein the third segment of tubing is configured to be connected to a third peristaltic pump head, and the fourth segment of tubing is configured to be connected to a fourth peristaltic pump head.~~

100. The tubing kit of any of claims 89-99, wherein the mixer comprises an input fluidly connected to the first portion of tubing, an input fluidly connected to the second portion of tubing, and output fluidly connected to the mixture container.

101. The tubing kit of any of claims 89-100, wherein the mixer comprises a Y-connector, a helical mixer, or a static mixer.

102. The tubing kit of any of claims 89-101, further comprising a first dampener connector that fluidly connects the first portion of tubing to the first dampener and to the mixer and a second dampener connector that fluidly connects the second portion of the tubing to the second dampener and to the mixer.

103. The tubing kit of any of claims 89-102, wherein the mixture container is a bag, vessel, or bottle.

104. A pulsation dampener for a fluid pump comprising:

a bioprocessing bag comprising a fluid inlet and a fluid outlet, wherein the fluid inlet is configured to be fluidly connected downstream of a fluid pump;

a housing configured to receive the bioprocessing bag, wherein the housing comprises a base and plurality of sidewalls forming a cavity for the bioprocessing bag and at least one sidewall comprises one or more notches configured to provide access to the fluid inlet and fluid outlet of the bioprocessing bag; and

a housing lid configured to attach to the plurality of sidewalls and close the housing.

105. The pulsation dampener of claim 104, wherein the bioprocessing bag comprises a gas inlet, wherein the gas inlet is configured to be fluidly connected to a gas source.

106. The pulsation dampener of claim 105, wherein the one or more notches are configured to provide access to the gas inlet of the bio processing bag.

107. The pulsation dampener of any one of claims 104-106, wherein the base of housing comprises a window.

108. The pulsation dampener of claim 107, wherein the window comprises an opening in the base of the housing or a transparent material in the base of the housing.

~~109. The pulsation dampener of any one of claims 104-109, wherein the housing lid comprises a window.~~

~~110. The pulsation dampener of claim 109, wherein the window comprises an opening in the housing lid or a transparent material in the housing lid.~~

~~111. The pulsation dampener of any one of claims 104-110, further comprising a front plate configured to be connected to at least one sidewall of housing and/or the housing lid, wherein the front plate comprises at least one aperture configured to receive the fluid inlet and fluid outlet.~~

~~112. The pulsation dampener of any one of claims 104-111, wherein the fluid pump is a cyclic pump.~~

~~113. The pulsation dampener of claim 112, wherein the cyclic pump is a peristaltic pump.~~

~~114. The pulsation dampener of any one of claims 104-113, wherein the fluid outlet is configured to be fluidly connected to a fluid storage container.~~

~~115. The pulsation dampener of any one of claims 104-114, wherein the fluid outlet comprises a check valve.~~