What is claimed is:

1. A pharmaceutical composition comprising an anti-tumor effective amount of a population of human T cells and a suitable carrier, wherein the T cells comprise a nucleic acid molecule encoding a chimeric antigen receptor (CAR), wherein the CAR comprises a CD19 antigen binding domain comprising, from the amino to the carboxy terminus, a light chain variable region and a heavy chain variable region of SEQ ID NO:20, wherein the CAR further comprises a transmembrane domain, a 4-1BB costimulatory signaling region, and a CD3 zeta signaling domain, wherein the T cells are from a human having cancer.

2. The pharmaceutical composition of claim 1, wherein the CD19 antigen binding domain is a scFv.

3. The pharmaceutical composition of claim 2, wherein the scFv comprises the amino acid sequence of SEQ ID NO.20.

4. The pharmaceutical composition of any one of claims 1-3, wherein the transmembrane domain is CD8 alpha transmembrane domain.

5. The pharmaceutical composition of claim 4, wherein the CD8 alpha transmembrane domain is encoded by a nucleic acid sequence comprising SEQ ID NO: 16.

6. The pharmaceutical composition of claim 4, wherein the CD8 alpha transmembrane domain comprises the amino acid sequence of SEQ ID NO: 22.

7. The pharmaceutical composition of any one of claims 1-6, wherein the 4-1BB costimulatory region is encoded by a nucleic acid sequence comprising SEQ ID NO: 17.

8. The pharmaceutical composition of any one of claims 1- 6, wherein the 4-1BB costimulatory region comprises the amino acid sequence of SEQ ID NO: 23.

9. The pharmaceutical composition of any one of claims 1-8, wherein the CD3 zeta signaling domain comprises the amino acid sequence of SEQ ID NO: 24.

10. The pharmaceutical composition of any one of claims 1- 8, wherein the CD3 zeta signaling domain is encoded by a nucleic acid sequence comprising SEQ ID NO: 18.

11. The pharmaceutical composition of any one of claims 1-10, wherein the CAR further comprises a CD8 alpha hinge domain.

12. The pharmaceutical composition of claim 11, wherein the CD8 alpha hinge domain is encoded by a nucleic acid sequence comprising SEQ ID NO: 15.

13. The pharmaceutical composition of claim 11, wherein the CD8 alpha hinge domain comprises the amino acid sequence comprising SEQ ID NO: 21.

14. The pharmaceutical composition of any one of claims 1-13, wherein the CD19 antigen binding domain is encoded by a nucleic acid sequence comprising SEQ ID NO: 14 or comprises the amino acid sequence SEQ ID NO:20, and the CD3zeta signaling domain is encoded by a nucleic acid sequence comprising SEQ ID NO: 18 or comprises the amino acid sequence SEQ ID NO:24.

15. The pharmaceutical composition of any one of claims 1-14, wherein the T cell is selected from the group consisting of a T helper cell, a cytotoxic T lymphocyte (CTL), a regulatory T cell and a memory T cell.

16. The pharmaceutical composition of claim 15, wherein the population of T cells exhibits an anti-tumor immunity when the antigen binding domain binds to its corresponding antigen.

17. A pharmaceutical composition comprising an anti-tumor effective amount of a population of human T cells and a suitable carrier, wherein the population of T-cells comprises cells that comprise a nucleic acid molecule that encodes a chimeric antigen receptor (CAR), wherein the CAR comprises a CD19 antigen binding domain comprising the amino acid sequence of SEQ ID NO: 20, a CD8 alpha hinge domain, a CD8 alpha transmembrane domain, a 4-1BB costimulatory signaling region, and a CD3 zeta signaling domain, wherein the T cells are T cells from a human having a cancer.

18. The pharmaceutical composition of claim 17, wherein the CD8 alpha transmembrane domain is encoded by a nucleic acid sequence comprising SEQ ID NO: 16.

19. The pharmaceutical composition of claim 17, wherein the CD8 alpha transmembrane domain comprises the amino acid sequence of SEQ ID NO: 22.

20. The pharmaceutical composition of any one of claims 17-19, wherein the 4-1BB costimulatory region is encoded by a nucleic acid sequence comprising SEQ ID NO: 17.

21. The pharmaceutical composition of any one of claims 17-19, wherein the 4-1BB costimulatory region comprises the amino acid sequence of SEQ ID NO: 23.

22. The pharmaceutical composition of any one of claims 17 and 20-21, wherein the CD8 alpha hinge domain is encoded by a nucleic acid sequence comprising SEQ ID NO: 15.

23. The pharmaceutical composition of any one of claims 17 and 20-21, wherein the CD8 alpha hinge domain comprises the amino acid sequence of SEQ ID NO: 21.

24. The pharmaceutical composition of any one of claims 17-23, wherein the T cell is selected from the group consisting of a T helper cell, a cytotoxic T lymphocyte (CTL), a regulatory T cell and a memory T cell.

25. The pharmaceutical composition of claim 24, wherein the population of T cells exhibits an anti-tumor immunity when the antigen binding domain binds to its corresponding antigen.

26. A pharmaceutical composition comprising an anti-tumor effective amount of a population of human T cells and a suitable carrier, wherein the T cells comprise a nucleic acid molecule that encodes a chimeric antigen receptor (CAR), wherein the CAR comprises a CD19 antigen binding domain comprising the amino acid sequence of SEQ ID NO: 20, a CD8 alpha hinge domain, a CD8 alpha transmembrane domain, a 4-1BB costimulatory signaling region, and a CD3 zeta signaling domain comprising the amino acid sequence of SEQ ID NO:24, wherein the T cells are T cells from a human having a cancer.

27. The pharmaceutical composition 26, wherein the CD19 antigen binding domain is an antigen-binding fragment.

28. The pharmaceutical composition of claim 27, wherein the CD19 antigen binding fragment is a scFv.

29. The pharmaceutical composition of any one of claims 26-28, wherein the CD8 alpha transmembrane domain is encoded by a nucleic acid sequence comprising SEQ ID NO: 16.

30. The pharmaceutical composition of any one of claims 26-28, wherein the CD8 alpha transmembrane domain comprises the amino acid sequence of SEQ ID NO: 22.

31. The pharmaceutical composition of any one of claims 26-30, wherein the 4-1BB costimulatory region is encoded by a nucleic acid sequence comprising SEQ ID NO: 17.

32. The pharmaceutical composition of any one of claims 26-30, wherein the 4-1BB costimulatory region comprises the amino acid sequence of SEQ ID NO: 23.

33. The pharmaceutical composition of any one of claims 26-28 and 31-32, wherein the CD8 alpha hinge domain is encoded by a nucleic acid sequence comprising SEQ ID NO: 15 or the CD8 alpha hinge domain comprises the amino acid sequence of SEQ ID NO: 21.

34. The pharmaceutical composition of any one of claims 26-33, wherein the T cell is selected from the group consisting of a T helper cell, a cytotoxic T lymphocyte (CTL), a regulatory T cell and a memory T cell.

35. The pharmaceutical composition of claim 34, wherein the population of T cells exhibits an anti-tumor immunity when the antigen binding domain binds to its corresponding antigen.

36. A pharmaceutical composition comprising an anti-tumor effective amount of a population of human T cells and a suitable carrier, wherein the T cells comprise a nucleic acid molecule that encodes a chimeric antigen receptor (CAR), wherein the CAR comprises a CD19 antigen binding domain, a transmembrane domain, a 4-1BB costimulatory signaling region, and a CD3 zeta signaling domain comprising the amino acid sequence of SEQ ID NO: 24, wherein the T cells are from a human having cancer.

37. The pharmaceutical composition of claim 36, wherein the CD19 antigen binding domain is an antibody or an antigen-binding fragment thereof.

38. The pharmaceutical composition of claim 37, wherein the CD19 antigen binding fragment is a scFv.

39. The pharmaceutical composition of claim 38, wherein the scFv comprises the amino acid sequence of SEQ ID NO: 20.

40. The pharmaceutical composition of claim 38, wherein the scFv is encoded by a nucleic acid sequence comprising SEQ ID NO: 14.

41. The pharmaceutical composition of any one of claims 36-40, wherein the transmembrane domain is a CD8 alpha transmembrane domain.

42. The pharmaceutical composition of claim 41, wherein the CD8 alpha transmembrane domain is encoded by a nucleic acid sequence comprising SEQ ID NO: 16.

43. The pharmaceutical composition of claim 41, wherein the CD8 alpha transmembrane domain comprises the amino acid sequence of SEQ ID NO: 22.

44. The pharmaceutical composition of any one of claims 36-43, wherein the 4-1BB costimulatory region is encoded by a nucleic acid sequence comprising SEQ ID NO: 17.

45. The pharmaceutical composition of any one of claims 36-43, wherein the 4-1BB costimulatory region comprises the amino acid sequence of SEQ ID NO: 23.

46. The pharmaceutical composition of any one of claims 36-45, wherein the CAR further comprises a hinge domain.

47. The pharmaceutical composition of any one of claims 36-46, wherein the T cell is selected from the group consisting of a T helper cell, a cytotoxic T lymphocyte (CTL), a regulatory T cell and a memory T cell.

48. The pharmaceutical composition of claim 47, wherein the population of T cells exhibits an anti-tumor immunity when the antigen binding domain binds to its corresponding antigen.

49. A human T cell comprising a nucleic acid molecule encoding a chimeric antigen receptor (CAR), wherein the CAR comprises a tumor antigen binding domain, a transmembrane domain, a costimulatory signaling region comprising 4-1BB, and a CD3 zeta signaling domain, the tumor antigen is CD19, wherein the T cell is obtained from a human

having cancer and the human is resistant to at least one chemotherapeutic agent, and the CD19 antigen binding domain comprises a light chain variable region and a heavy chain variable region of SEQ ID NO:20.

50. The human T cell of claim 49, wherein the CD19 antigen binding domain is encoded by a nucleic acid sequence comprising SEQ ID NO: 14.

51. The human T cell of claim 49, wherein the CD19 antigen binding domain comprises the amino acid sequence of SEQ ID NO: 20.

52. The human T cell of any one of claims 49-51, wherein the transmembrane domain is CD8 alpha transmembrane domain.

53. The human T cell of claim 52, wherein the CD8 alpha transmembrane domain is encoded by a nucleic acid sequence comprising SEQ ID NO: 16.

54. The human T cell of claim 52, wherein the CD8 alpha transmembrane domain comprises the amino acid sequence of SEQ ID NO:22.

55. The human T cell of claim 49, wherein the 4-1BB costimulatory region is encoded by a nucleic acid sequence comprising SEQ ID NO:17.

56. The human T cell of claim 49, wherein the 4-1BB costimulatory region comprises the amino acid sequence of SEQ ID NO:23.

57. The T human cell of any one of claims 49-56, wherein the CD3 zeta signaling domain is encoded by a nucleic acid sequence comprising SEQ ID NO:18 or wherein the CD3 zeta signaling domain comprises the amino acid sequence of SEQ ID NO:24.

58. The human T cell of any one of claims 49-57, wherein the CAR further comprises a CD8 alpha hinge domain.

59. The human T cell of claim 58, wherein the CD8 alpha hinge domain is encoded by a nucleic acid sequence comprising SEQ ID NO:15.

60. The human T cell of claim 58, wherein the CD8 alpha hinge domain comprises the amino acid sequence of SEQ ID NO:21.

61. The human T cell of claim 49, wherein the tumor antigen binding domain comprises CD19, the transmembrane domain comprises CD8 alpha transmembrane domain, the costimulatory region comprises 4-1BB and wherein the CAR further comprises a CD8 alpha hinge domain.

62. The T cell of claim 61, wherein the CD19 antigen binding domain is encoded by a nucleic acid sequence comprising SEQ ID NO:14 and the CD3zeta signaling domain is encoded by a nucleic acid sequence comprising SEQ ID NO:18.

63. The human T cell of claim 49-62, wherein the T cell is selected from the group consisting of a T helper cell, a cytotoxic T lymphocyte (CTL), a regulatory T cell and a memory T cell.

64. The human T cell of claim 49, wherein the CAR comprises the amino acid sequence of SEQ ID NO:12.

65. The human T cell of claim 49, wherein the CAR comprises the nucleic acid sequence of SEQ ID NO:8.

66. A human T cell comprising a vector, the vector comprising a nucleic acid molecule encoding the CAR as defined in any one of claims 49-65.

67. A pharmaceutical composition comprising an anti-tumor effective amount of a population of human T cells and a suitable carrier, wherein the T cells comprise a nucleic acid molecule that encodes a chimeric antigen receptor (CAR), wherein the CAR comprises a CD19 antigen binding domain comprising the amino acid sequence of SEQ ID NO:20, a CD8 alpha transmembrane domain comprising the amino acid sequence of SEQ ID NO:22, a 4-1BB costimulatory signaling region comprising the amino acid sequence of SEQ ID NO:23, a CD8 alpha hinge domain comprising the amino acid sequence of SEQ ID NO:21, and a CD3 zeta signaling domain comprising the amino acid sequence of SEQ ID NO: 24, wherein the T cells are from a human having cancer.

68. The human T cell of any one of claims 49-66 for use in treating cancer in a human.

69. A use of the human T cell of any one of claims 49-66 for treating cancer in a human.

70, A use of the human T cell of any one of claims 49-66 in the manufacture of a medicament for treating cancer in a human.

71. The human T cell of claim 68, wherein the cancer is a hematological malignancy.

72. The human T cell of claim 68, wherein the cancer is leukemia or lymphoma.

73. The human T cell of claim 72, wherein the cancer is selected from the group consisting of adult acute lymphocytic leukemia, chronic lymphocytic leukemia, pre-B acute lymphocytic leukemia (pediatric indication), mantle cell lymphoma, diffuse large B cell lymphoma, non-Hodgkin's lymphoma, multiple myeloma and Hodgkin's disease.

74. The human T cell of any one of claims 68, 71, 72 and 73, wherein the human is resistant to at least one chemotherapeutic agent.

75. The pharmaceutical composition of any one of claims 1-48, and 67 for use in treating cancer in a human.

76. A use of the pharmaceutical composition of any one of claims 1-48, and 67 in the manufacture of a medicament for treating cancer in a human.

77. The pharmaceutical composition of any one of claims 1-48, and 67, wherein the cancer is a hematological malignancy.

78. The pharmaceutical composition of claim 77, wherein the cancer is leukemia or lymphoma.

79. The pharmaceutical composition of claim 78, wherein the cancer is selected from the group consisting of adult acute lymphocytic leukemia, chronic lymphocytic leukemia, pre-B acute lymphocytic leukemia (pediatric indication), mantle cell lymphoma, diffuse large B cell lymphoma, non-Hodgkin's lymphoma, multiple myeloma and Hodgkin's disease.

80. The pharmaceutical composition of any one claims 1-48 and 77-79, wherein the human is resistant to at least one chemotherapeutic agent.

81. The use as defined in claim 69, 70, and 76, wherein the human is resistant to at least one chemotherapeutic agent.

82. The pharmaceutical composition of any one of claims 1-48, and 67, wherein the suitable carrier, is a diluent, an excipient or a buffer.

83. The pharmaceutical composition of claim 82, wherein the buffer is neutral buffer saline or phosphate buffer saline.

84. The pharmaceutical composition of claim 82 or 83 further comprising a carbohydrate.

85. The human T cell of any one of claims 49-65, wherein the T cell comprises a vector that comprises the nucleic acid molecule.

86. The human T cell of claim 85, wherein the vector is a lentiviral vector.

87. The pharmaceutical composition of claim 1-48, and 67, wherein the T-cell is isolated from a blood sample obtained from a human before the human is treated with a modality selected from the group consisting of an antiviral agent, chemotherapy, radiation, an immunosuppressive agent and an antibody.

88. The pharmaceutical composition of claim 87, wherein the antibody is selected from the group consisting of anti-CD3 antibody, natalizumab and efalizumab.

89. The pharmaceutical composition of claim 87, wherein the immunosuppressive agent is selected from the group consisting of cyclosporin, azathioprine, methotrexate, mycophenolate, FK506, CAMPATH®, cytoxan, fludarabine, rapamycin, mycophenolic acid, a steroid, and FR901228.

90. The pharmaceutical composition of claim 1-48, and 67, wherein the anti-tumor effective amount of the population of T cells is 10^4 to 10^9 cells per kg body weight of a human in need of such cells.

91. The pharmaceutical composition of claim 1-48, and 67, wherein the anti-tumor effective amount of the population of T cells is 10^5 to 10^6 cells per kg body weight of a human in need of such cells.