WHAT IS CLAIMED IS:

1. A polynucleotide encoding: (a) a CD3 zeta signaling domain, (b) an extracellular ligand-binding domain comprising a Natural Killer Group 2 member D receptor (NKG2D), and (c) a DNAX-activating protein 10 (DAP10), wherein the nucleotide sequence encoding DAP10 is operably linked to nucleotide sequence comprising an internal ribosome entry site (IRES).

2. The polynucleotide of claim 1 which is an mRNA.

3. The polynucleotide of claim 1 which is operably linked to at least one regulatory element for the expression of the chimeric receptor complex.

4. A vector comprising the polynucleotide of claim 1, wherein the polynucleotide is operatively linked to at least one regulatory element for expression of the chimeric receptor.

5. The vector of claim 2, wherein the vector is a retrovirus.

6. An isolated genetically engineered cell comprising the polynucleotide of claim 1.

7. The isolated genetically engineered cell of claim 6, which is a natural killer (NK) cell.

8. The isolated genetically engineered cell of claim 6, which is a T lymphocyte.

9. The isolated genetically engineered cell of any one of claims 6 -8, which is a human cell.

10. The isolated genetically engineered cell of claim 9, which is an autologous cell isolated from a patient having a cancer or an infectious disease.

11. The isolated genetically engineered cell of claim 9, which is an allogenic cell isolated from a donor.

12. The isolated genetically engineered cell of claim 10 which is an autologous cell isolated from a patient having a cancer, wherein the cancer is a T-cell acute lymphocytic leukemia (ALL), a B-cell acute lymphocytic leukemia, a lymphoblastic leukemia, a B-cell chronic lymphocytic leukemia or a B-cell non-Hodgkin's lymphoma, prostate carcinoma, rhabdomyosarcoma, neuroblastoma, Ewing sarcoma, colon carcinoma, gastric carcinoma, lung squamous cell carcinoma, hepatoma, or breast carcinoma.

13. A method of increasing or enhancing cytotoxicity of an NK cell or T lymphocyte in a mammal in need thereof comprising administering to said mammal an expanded population of NK cells, wherein said NK cells comprise a polynucleotide comprising: (a) a nucleotide sequence encoding a CD3 zeta signaling domain, (b) a nucleotide sequence encoding an extracellular ligand-binding domain comprising an NKG2D receptor, (c) a nucleotide sequence comprising an IRES; and (d) a nucleotide sequence encoding a DAP10 domain operably linked to said IRES for expressing DAP10.

14. The method of claim 13, wherein the cytotoxicity of the NK cell is increased or enhanced without significant increase in cytotoxic activity against non-tumor cells in said mammal.

15. The method of claim 14, wherein the cytotoxicity against non-transformed cells is less than 20% cytoxicity.

16. A method for reducing tumor burden in an mammal, said method comprising administering to a mammal in need of said treatment a therapeutically effective amount of an expanded population of NK cells, wherein said NK cells comprise a polynucleotide comprising: (a) a nucleotide sequence encoding a CD3 zeta signaling domain, (b) a nucleotide sequence encoding an extracellular ligand-binding domain comprising an NKG2D receptor, (c) a nucleotide sequence comprising an IRES; and (d) a nucleotide sequence encoding a DAP10 domain operably linked to said IRES for expressing DAP10.

17. A method for treating, ameliorating, or protecting a mammal against cancer or infections disease, said method comprising administering to a mammal in need thereof a therapeutically effective amount of an expanded population of NK cells, wherein said NK cells comprise a polynucleotide comprising: (a) a nucleotide sequence encoding a CD3 zeta signaling domain, (b) a nucleotide sequence encoding an extracellular ligand-binding domain

~~comprising an NKG2D receptor, (c) a nucleotide sequence comprising an IRES, and (d) a~~ nucleotide sequence encoding a DAP10 domain operably linked to said IRES for expressing DAP10.

18. A method for treating, protecting against, or ameliorating a cancer or an infections disease in a mammal, said method comprising administering to a mammal in need thereof a therapeutically effective amount of an expanded population of NK cells or T cells, wherein said NK cells or T cells comprise (a) a first mRNA encoding an NKG2D receptor domain and a CD3 zeta signaling domain and (b) a second mRNA encoding a DAP10 polypeptide, which first and second mRNA were delivered into said NK cell or T cell by electroporation.

19. The method of claim 18, wherein the cell is an NK cell.

20. The method of claim 13, 14, 17, or 18, wherein said NK cells are donor NK cells.

21. The method of claim 13, 14, 17, or 18, wherein said NK cells are autologous NK cells.

22. The method of claim 13, 14, 17, or 18, wherein said CD3 zeta signaling domain comprises the amino acid sequence of SEQ ID NO:10.

23. The method of claim 13, 14, or 17 wherein the CD3 zeta signaling domain is encoded by the nucleic acid sequence of SEQ ID NO:9.

24. The method of claim 13, 14, 17, or 18, wherein the NKG2D receptor domain comprises the amino acid sequence of SEQ ID NO:12.

25. The method of claim 13, 14, or 17, wherein the NKG2D receptor domain is encoded by the nucleic acid sequence of SEQ ID NO:11.

26. The method of claim 13, 14, 17, or 18, wherein the DAP10 domain comprises the amino acid sequence of SEQ ID NO:14.

27. The method of claim 13, 14, or 17, wherein the DAP10 domain is encoded by ~~the nucleic acid sequence of SEQ ID NO:13.~~

28. The method of claim 13, 14, 17, or 18, wherein the CD3 zeta signaling domain comprises the amino acid sequence of SEQ ID NO:10, the NKG2D receptor domain comprises the amino acid sequence of SEQ ID NO:12, and the DAP10 domain comprises the amino acid sequence of SEQ ID NO:14.

29. The method of claim 13, 14, or 17, wherein the CD3zeta signaling domain is encoded by the nucleic acid sequence of SEQ ID NO:9, the NKG2D receptor domain is encoded by the nucleic acid sequence of SEQ ID NO:11, and the DAP10 domain is encoded by the nucleic acid sequence of SEQ ID NO:13.

30. A method for treating a mammal suffering from cancer comprising administering to said mammal an NK cell or a T lymphocyte, wherein the NK cell or T lymphocyte comprises the vector of claim 2.

31. The method of claim 30 wherein the vector is a retroviral vector.

32. The method of claim 30, wherein the mammal is suffering from a cancer of B-cell origin.

33. The method of claim 13, 14, 17, 18, or 30, wherein the mammal is suffering from a cancer of B-cell origin.

34. The method of claim 13, 14, 17, 18, or 30, wherein the cancer is selected from the group consisting of B-lineage acute lymphoblastic leukemia, B-cell chronic lymphocytic leukemia and B-cell non-Hodgkin's lymphoma.

35. The method of claim 13, 14, 17, 18, or 30, wherein the mammal is suffering from lung cancer, melanoma, breast cancer, prostate cancer, colon cancer, renal cell carcinoma, ovarian cancer, neuroblastoma, rhabdomyosarcoma, leukemia and lymphoma, acute lymphoblastic leukemia, small cell lung cancer, Hodgkin's lymphoma, or childhood acute lymphoblastic leukemia.

36. The method of claim 13, 14, 17, 18, or 30, wherein the mammal is suffering from a cancer selected from the group consisting of lung cancer, melanoma, breast cancer, prostate cancer, colon cancer, renal cell carcinoma, ovarian cancer, neuroblastoma, rhabdomyosarcoma, lymphoma, acute lymphoblastic leukemia, small cell lung carcinoma, Hodgkin's lymphoma, and childhood acute lymphoblastic leukemia, fibrosarcoma,

~~myxosarcoma, liposarcoma, chondrosarcoma, osteogenic sarcoma, chordoma, angiosarcoma,~~ endotheliosarcoma, lymphangiosarcoma, lymphangioendotheliosarcoma, synovioma, mesothelioma, Ewing's tumor, leiomyosarcoma, pancreatic cancer, squamous cell carcinoma, basal cell carcinoma, adenocarcinoma, sweat gland carcinoma, sebaceous gland carcinoma, papillary carcinoma, papillary adenocarcinomas, cystadenocarcinoma, medullary carcinoma, bronchogenic carcinoma, hepatoma, bile duct carcinoma, choriocarcinoma, seminoma, embryonal carcinoma, Wilms' tumor, cervical cancer, testicular tumor, bladder carcinoma, epithelial carcinoma, glioma, astrocytoma, medulloblastoma, craniopharyngioma, ependymoma, pinealoma, hemangioblastoma, acoustic neuroma, oligodendroglioma, meningioma, retinoblastoma, acute lymphocytic leukemia, acute myelocytic leukemia; chronic leukemia, polycythemia vera, lymphoma, multiple myeloma, Waldenström's macroglobulinemia, and heavy chain disease.

37. The method of claim 36, wherein the cancer is selected from the group consisting of T-cell ALL, B-cell ALL, osteosarcoma, prostate carcinoma, rhabdomyosarcoma, neuroblastoma, Ewing sarcoma, colon carcinoma, gastric carcinoma, lung squamous cell ~~carcinoma, hepatoma, and breast carcinoma.~~

WHAT IS CLAIMED IS:

1. A polynucleotide encoding a chimeric receptor complex comprising (a) a CD3 zeta cytoplasmic domain, (b) a Natural Killer Group 2 member D (NKG2D) receptor, and (c) a DNAX-activating protein 10 (DAP10) polypeptide.

2. The polynucleotide of claim 1, wherein the CD3 zeta cytoplasmic domain comprises the amino acid sequence of SEQ ID NO: 10.

3. The polynucleotide of claim 2, wherein the CD3 zeta cytoplasmic domain is encoded by the nucleic acid sequence of SEQ ID NO: 9.

4. The polynucleotide of claim 1, wherein the NKG2D receptor comprises the amino acid sequence of SEQ ID NO: 12.

5. The polynucleotide of claim 4, wherein the NKG2D receptor is encoded by the nucleic acid sequence of SEQ ID NO: 11.

6. The polynucleotide of claim 1, wherein the DAP10 polypeptide comprises the amino acid sequence of SEQ ID NO: 14.

7. The polynucleotide of claim 6, wherein the DAP10 polypeptide is encoded by the nucleic acid sequence of SEQ ID NO: 13.

8. The polynucleotide of claim 1, wherein the CD3 zeta cytoplasmic domain comprises the amino acid sequence of SEQ ID NO: 10, the NKG2D receptor comprises the amino acid sequence of SEQ ID NO: 12, and the DAP10 polypeptide comprises the amino acid sequence of SEQ ID NO: 14.

9. The polynucleotide of claim 1, wherein the CD3 zeta cytoplasmic domain is encoded by the nucleic acid sequence of SEQ ID NO: 9, the NKG2D receptor is encoded by the nucleic acid sequence of SEQ ID NO: 11, and the DAP10 polypeptide is encoded by the nucleic acid sequence of SEQ ID NO: 13.

10. The polynucleotide of claim 1 which is an mRNA.

11. A vector comprising the polynucleotide of claim 1, wherein the polynucleotide is operably linked to at least one regulatory element for expression of the chimeric receptor complex.

12. The vector of claim 11, wherein the CD3 zeta cytoplasmic domain and the NKG2D receptor are expressed as a single chimeric receptor protein.

13. The vector of claim 11, wherein the DAP10 polypeptide is expressed as a separate molecule from the CD3 zeta cytoplasmic domain and the NKG2D receptor.

14. The vector of claim 13, wherein the nucleotide sequence encoding the DAP10 polypeptide is operably linked to a nucleotide sequence comprising an internal ribosome entry site (IRES).

15. An isolated genetically engineered cell comprising the polynucleotide of claim 1.

16. The genetically engineered cell of claim 15, which is a natural killer (NK) cell.

17. Use of a therapeutic effective amount of natural killer (NK) cells expressing a chimeric receptor complex comprising (a) a CD3 zeta cytoplasmic domain, (b) a Natural Killer Group 2 member D (NKG2D) receptor, and (c) a DNAX-activating protein 10 (DAP10) polypeptide for the manufacture of a medicament for enhancing natural killer (NK) cells cytotoxicity, or for treating or preventing cancer or an infectious disease.

18. The use of claim 17, wherein the medicament is prepared to be administered to mammal NK cells to enhance the natural killer (NK) cells cytotoxicity.

19. The use of claim 17, wherein said NK cells are autologous NK cells.

20. The use of claim 17, wherein the CD3 zeta cytoplasmic domain comprises the amino acid sequence of SEQ ID NO: 10, the NKG2D receptor comprises the amino acid sequence of SEQ ID NO: 12, and the DAP10 polypeptide comprises the amino acid sequence of SEQ ID NO: 14.

21. A polynucleotide of claim 1 for use in medicine.