CLAIMS

What is claimed is:

1. A vector comprising a nucleic acid encoding:
   a) a chimeric antigen receptor (CAR); and
   b) a membrane-bound anti-IL6 (mb-aIL6) comprising:
      i) a CD8α signal peptide domain;
      ii) an anti-IL-6 variable light chain domain having at least 90% sequence identity to SEQ ID NO: 4;
      iii) an anti-IL-6 variable heavy chain domain having at least 90% sequence identity to SEQ ID NO: 8;
      iv) a linker domain joining the variable light chain domain and the variable heavy chain domain; and
      v) a hinge and transmembrane domain.

2. The vector of Claim 1, wherein one or more of the anti-IL-6 variable light chain domain and the anti-IL-6 variable heavy chain domain are human anti-IL6 variable light and variable heavy chains domains.

3. The vector of any one of Claims 1-2, wherein the linker domain is $(G4S)_x$, wherein x is an integer from 1 to 100.

4. The vector of any one of Claims 1-2, wherein the linker domain is $(G4S)_3$.

5. The vector of any one of Claim 1-2, wherein the hinge and transmembrane domain are CD8α hinge and transmembrane domain.

6. The vector of Claim 5, wherein the hinge and transmembrane domain comprises SEQ ID NO: 10.

7. The vector of Claim 1, wherein the CD8α signal peptide domain comprises SEQ ID NO: 2.

8. The vector of Claim 1, wherein the chimeric antigen receptor is an anti-CD19-41BB-CD3ζ chimeric antigen receptor (CAR).

9. The vector of Claim 8, wherein the mb-aIL6 is coupled to the anti-CD19-41BB-CD3ζ by a P2A sequence.

10. A vector comprising a nucleic acid encoding:
    a) a chimeric antigen receptor; and
    b) a membrane-bound anti-IL6 (mb-aIL6) comprising:
        i) an anti-IL-6 variable light chain domain having at least 90% sequence identity to SEQ ID NO: 4;
        ii) an anti-IL-6 variable heavy chain domain having at least 90% sequence identity to SEQ ID NO: 8;
        iii) a first linker domain joining the variable light chain domain and the variable heavy chain domain;
        iv) a second linker domain N-terminal to the anti-IL-6 variable heavy chain domain;
        v) a hinge and transmembrane domain N-terminal to the second linker domain; and
        vi) an intracellular signaling domain N-terminal to the hinge and transmembrane domain.

11. The vector of Claim 10, wherein the intracellular signaling domain is a 41BB domain.

12. The vector of Claim 10, further comprising a co-stimulatory domain N-terminal to the intracellular signaling domain.

13. The vector of Claim 12, wherein the co-stimulatory domain is a CD3ζ domain.

14. Use of T cells in the manufacture of a medicament for reducing IL-6 concentration in a mammal, wherein the T cells express a vector that comprises a nucleic acid encoding:
    a) a chimeric antigen receptor (CAR); and
    b) a membrane-bound anti-IL6 (mb-aIL6) comprising:
        i) a CD8α signal peptide domain;
        ii) an anti-IL-6 variable light chain domain having at least 90% sequence identity to SEQ ID NO: 4;

iii) an anti-IL-6 variable heavy chain domain having at least 90% sequence identity to SEQ ID NO: 8;

iv) a linker domain joining the variable light chain domain and the variable heavy chain domain; and

v) a hinge and transmembrane domain.

15. The use of Claim 14, wherein the mammal is a human.

16. The use of Claim 14 or 15, further comprising culturing the T cell to generate new T cells that express the chimeric antigen receptor and the mb-aIL6.

17. The use of Claim 14 or 15, further comprising reducing risk of cytokine release syndrome (CRS).

18. The use of Claim 14 or 15, wherein the mammal is suffering from an autoimmune disease, an inflammatory disease, or a lymphoproliferative disorder, and wherein reducing IL-6 concentration in the mammal treats the autoimmune disease, the inflammatory disease, or the lymphoproliferative disorder, respectively.

19. The use of Claim 18, wherein the mammal is suffering from rheumatoid arthritis, systemic lupus erythematosus, graft-versus-host disease, or Castleman disease, and wherein reducing IL-6 concentration treats rheumatoid arthritis, systemic lupus erythematosus, graft-versus-host disease, or Castleman disease, respectively.