CLAIMS

1. A chimeric antigen receptor, comprising a first antigen binding domain and a second antigen binding domain, said first antigen binding domain targets a G protein-coupled receptor class C group 5 member D (GPRC5D) protein, and said second antigen binding domain targets the GPRC5D protein, wherein said first antigen binding domain comprises at least one CDR of an antibody heavy chain variable region VH, said VH comprises an amino acid sequence as set forth in any one of SEQ ID NO: 15, SEQ ID NO: 19, SEQ ID NO: 24 and SEQ ID NO: 30.

2. The chimeric antigen receptor of claim 1, wherein said first antigen binding domain and/or said second antigen binding domain comprises an antibody or an antigen binding fragment thereof, wherein said antigen binding fragment comprises Fab, Fab', F(ab)2, an Fv fragment, F(ab')2, scFv, di-scFv, VHH and dAb.

3. The chimeric antigen receptor of any one of claims 1-2, wherein said first antigen binding domain comprises a HCDR1, a HCDR2, and a HCDR3, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 33, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 34 ($IX_1X_2X_3X_4GX_5T$, wherein X_1 is N or T, X_2 is S or W, X_3 is G or S, X_4 is D or G, and X_5 is N, S or T), said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 35.

4. The chimeric antigen receptor of any one of claims 1-3, wherein said first antigen binding domain comprises a HCDR1, a HCDR2, and a HCDR3, and said HCDR3 comprises an amino acid sequence as set forth in any one of SEQ ID NO: 10, SEQ ID NO: 18, SEQ ID NO: 22 and SEQ ID NO: 27, said HCDR2 comprises an amino acid sequence as set forth in any one of SEQ ID NO: 9, SEQ ID NO: 17, SEQ ID NO: 21 and SEQ ID NO: 26, said HCDR1 comprises an amino acid sequence as set forth in any one of SEQ ID NO: 8, SEQ ID NO: 16, SEQ ID NO: 20 and SEQ ID NO: 25.

5. The chimeric antigen receptor of any one of claims 1-4, wherein said first antigen binding domain comprises a HCDR1, a HCDR2 and a HCDR3, and said HCDR1, HCDR2, HCDR3 comprise any one group of amino acid sequences selected from:

(1) said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 8, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 9, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 10;

(2) said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 16, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 17, and said HCDR3

comprises an amino acid sequence as set forth in SEQ ID NO: 18;

(3) said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 20, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 21, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 22; and

(4) said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 25, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 26, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 27.

6. The chimeric antigen receptor of any one of claims 1-5, wherein said first antigen binding domain is a VHH, and said VHH comprises an amino acid sequence as set forth in any one of SEQ ID NO: 15, SEQ ID NO: 19, SEQ ID NO: 24 and SEQ ID NO: 30.

7. The chimeric antigen receptor of any one of claims 1-6, wherein said second antigen binding domain comprises a HCDR1, a HCDR2, and a HCDR3, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 33, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 34 ($IX_1X_2X_3X_4GX_5T$, wherein X_1 is N or T, X_2 is S or W, X_3 is G or S, X_4 is D or G, and X_5 is N, S or T), said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 35.

8. The chimeric antigen receptor of any one of claims 1-7, wherein said second antigen binding domain comprises a HCDR1, a HCDR2, and a HCDR3, and said HCDR3 comprises an amino acid sequence as set forth in any one of SEQ ID NO: 10, SEQ ID NO: 18, SEQ ID NO: 22 and SEQ ID NO: 27, said HCDR2 comprises an amino acid sequence as set forth in any one of SEQ ID NO: 9, SEQ ID NO: 17, SEQ ID NO: 21 and SEQ ID NO: 26, said HCDR1 comprises an amino acid sequence as set forth in any one of SEQ ID NO: 8, SEQ ID NO: 16, SEQ ID NO: 20 and SEQ ID NO: 25.

9. The chimeric antigen receptor of any one of claims 1-8, wherein said second antigen binding domain comprises a HCDR1, a HCDR2 and a HCDR3, and said HCDR1, HCDR2, HCDR3 comprise any one group of amino acid sequences selected from:

(1) said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 8, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 9, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 10;

(2) said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 16, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 17, and said HCDR3

comprises an amino acid sequence as set forth in SEQ ID NO: 18;

(3) said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 20, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 21, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 22; and

(4) said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 25, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 26, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 27.

10. The chimeric antigen receptor of any one of claims 1-9, wherein said second antigen binding domain is a VHH, and said VHH comprises an amino acid sequence as set forth in any one of SEQ ID NO: 15, SEQ ID NO: 19, SEQ ID NO: 24 and SEQ ID NO: 30.

11. The chimeric antigen receptor of any one of claims 1-10, wherein said first antigen binding domain and said second antigen binding domain comprise a HCDR1, a HCDR2 and a HCDR3, respectively, and the sequences of said HCDR1, said HCDR2 and said HCDR3 of said first antigen binding domain and said second antigen binding domain are selected from any one group of amino acid sequences below:

(1) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 8, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 9, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 10; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 8, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 9, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 10;

(2) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 8, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 9, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 10; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 16, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 17, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 18;

(3) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 8, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 9, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 10; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 20,

said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 21, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 22;

(4) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 8, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 9, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 10; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 25, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 26, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 27;

(5) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 16, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 17, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 18; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 8, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 9, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 10;

(6) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 16, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 17, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 18; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 16, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 17, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 18;

(7) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 16, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 17, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 18; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 20, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 21, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 22;

(8) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 16, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 17, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 18; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 25, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 26, and said HCDR3

comprises an amino acid sequence as set forth in SEQ ID NO: 27;

(9) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 20, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 21, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 22; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 8, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 9, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 10;

(10) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 20, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 21, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 22; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 16, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 17, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 18;

(11) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 20, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 21, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 22; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 20, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 21, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 22;

(12) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 20, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 21, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 22; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 25, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 26, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 27;

(13) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 25, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 26, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 27; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 8, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 9, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 10;

(14) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 25, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 26, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 27; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 16, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 17, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 18;

(15) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 25, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 26, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 27; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 20, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 21, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 22; and

(16) first antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 25, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 26, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 27; second antigen binding domain: said HCDR1 comprises an amino acid sequence as set forth in SEQ ID NO: 25, said HCDR2 comprises an amino acid sequence as set forth in SEQ ID NO: 26, and said HCDR3 comprises an amino acid sequence as set forth in SEQ ID NO: 27.

12. The chimeric antigen receptor of any one of claims 1-11, wherein said first antigen binding domain and said second antigen binding domain are connected by a linker, said linker comprises an amino acid sequence of (GGGGS)n and/or an amino acid sequence of (EAAAK)n, wherein said n is any positive integer from 1-10.

13. The chimeric antigen receptor of any one of claims 1-12, comprising a costimulatory signal region, an intracellular signaling domain, a transmembrane region, a hinge region, and/or a signal peptide, wherein said costimulatory signal region comprises an intracellular costimulatory signal region derived from one or more proteins selected from a group consisting of: CD28, 4-1BB, CD27, CD2, CD7, CD8, OX40, CD226, DR3, SLAM, CDS, ICAM-1, NKG2D, NKG2C, B7-H3, 2B4, FcεRIγ, BTLA, GITR, HVEM, DAP10, DAP12, CD30, CD40, CD40L, TIM1, PD-1, LFA-1, LIGHT, JAML, CD244, CD100, ICOS, a ligand of CD83, CD40, and MyD88, said intracellular signaling domain comprises an intracellular signal region derived from one or more proteins selected from a group consisting of: CD3ζ, CD3δ, CD3γ, CD3ε, CD79a, CD79b, FcεRIγ, FcεRIβ,

FcγRIIa, bovine leukemia virus gp30, Epstein-Barr virus (EBV) LMP2A, simian immunodeficiency virus PBj14 Nef, Kaposi's sarcoma herpes virus (HSKV), DAP10, DAP-12, and a domain at least containing one ITAM, said transmembrane region comprises a transmembrane domain derived from one or more proteins selected from a group consisting of: CD8, CD28, 4-1BB, CD4, CD27, CD7, PD-1, TRAC, TRBC, CD3ε, CD3ζ, CTLA-4, LAG-3, CD5, ICOS, OX40, NKG2D, 2B4, CD244, FcεRIγ, BTLA, CD30, GITR, HVEM, DAP10, CD2, NKG2C, LIGHT, DAP12, CD40L, TIM1, CD226, DR3, CD45, CD80, CD86, CD9, CD16, CD22, CD33, CD37, CD64, CD134, CD137, CD154, and SLAM, said hinge region comprises a hinge region derived from one or more proteins selected from a group consisting of: CD28, IgG1, IgG4, IgD, 4-1BB, CD4, CD27, CD7, CD8, PD-1, ICOS, OX40, NKG2D, NKG2C, FcεRIγ, BTLA, GITR, DAP10, CD40L, TIM1, CD226, SLAM, CD30, and LIGHT, said signal peptide is derived from a signal peptide of CD8 protein.

14. The chimeric antigen receptor of any one of claims 1-13, further comprising a low-density lipoprotein receptor-related protein or a fragment thereof.

15. One or more isolated nucleic acid molecules, encoding the chimeric antigen receptor of any one of claims 1-14.

16. A vector, comprising the nucleic acid molecule of claim 15.

17. A cell, comprising the chimeric antigen receptor of any one of claims 1-14, the nucleic acid molecule of claim 15, and/or the vector of claim 16.

18. The cell of claim 17, which is an immune effector cell, comprising T cells, B cells, natural killer cells (NK cells), macrophages, NKT cells, monocytes, dendritic cells, granulocytes, lymphocytes, leukocytes, peripheral blood mononuclear cells, embryonic stem cells, lymphoid progenitor cells and/or pluripotent stem cells.

19. A pharmaceutical composition, comprising the chimeric antigen receptor of any one of claims 1-14, the nucleic acid molecule of claim 15, the vector of claim 16, and/or the cell of claim 17, as well as a pharmaceutically acceptable carrier.

20. Use of the chimeric antigen receptor of any one of claims 1-14, the nucleic acid molecule of claim 15, the vector of claim 16, the cell of claim 17, and/or the pharmaceutical composition of claim 19 in the manufacture of a medicament for preventing, treating and/or alleviating a disease and/or a disorder.