

The presently disclosed subject matter further provides use of an effective amount of the immunoresponsive cell as described herein, in the manufacture of a medicament for reducing tumor burden in a subject with multiple myeloma.

5 The presently disclosed subject matter further provides use of an effective amount of the immunoresponsive cell as described herein, in the manufacture of a medicament for increasing or lengthening survival of a subject having multiple myeloma.

The presently disclosed subject matter further provides a chimeric antigen receptor (CAR), comprising an extracellular antigen-binding domain that binds to a
10 G-protein coupled receptor family C group 5 member D (GPRC5D), a transmembrane domain and an intracellular domain, wherein the extracellular antigen-binding domain comprises:

(a) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 124, a CDR2 comprising the amino acid
15 sequence set forth in SEQ ID NO: 125 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 126; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 127, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 128 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 129;

20 (b) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 130, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 131 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 132; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 133, a CDR2
25 comprising the amino acid sequence set forth in SEQ ID NO: 134 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 135;

(c) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 136, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 137 and a CDR3 comprising the amino acid
30 sequence set forth in SEQ ID NO: 138; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 139, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 140 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 141;

(d) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 142, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 143 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 144; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 145, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 146 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 147;

(e) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 148, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 149 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 150; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 151, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 152 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 153;

(f) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 154, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 155 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 156; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 157, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 158 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 159;

(g) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 160, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 161 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 162; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 163, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 164 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 165;

(h) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 166, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 167 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 168; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 169, a CDR2

comprising the amino acid sequence set forth in SEQ ID NO: 170 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 171;

(i) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 172, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 173 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 174; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 175, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 176 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 177;

(j) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 178, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 179 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 180; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 181, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 182 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 183;

(k) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 184, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 185 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 186; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 187, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 188 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 189;

(l) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 190, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 191 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 192; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 193, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 194 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 195;

(m) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 196, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 197 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 198; and a light chain variable region comprising a

CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 199, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 200 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 201;

5 (n) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 202, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 203 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 204; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 205, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 206 and a CDR3
10 comprising the amino acid sequence set forth in SEQ ID NO: 207;

(o) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 208, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 209 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 210; and a light chain variable region comprising a
15 CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 211, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 212 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 213;

(p) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 214, a CDR2 comprising the amino acid
20 sequence set forth in SEQ ID NO: 215 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 216; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 217, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 218 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 219;

25 (q) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 220, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 221 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 222; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 223, a CDR2
30 comprising the amino acid sequence set forth in SEQ ID NO: 224 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 225;

(r) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 226, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 227 and a CDR3 comprising the amino acid

sequence set forth in SEQ ID NO: 228; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 229, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 230 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 231;

5 (s) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 232, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 233 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 234; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 235, a CDR2
10 comprising the amino acid sequence set forth in SEQ ID NO: 236 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 237;

(t) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 238, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 239 and a CDR3 comprising the amino acid
15 sequence set forth in SEQ ID NO: 240; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 241, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 242 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 243;

(u) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 244, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 245 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 246; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 247, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 248 and a CDR3
25 comprising the amino acid sequence set forth in SEQ ID NO: 249;

(v) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 250, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 251 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 252; and a light chain variable region comprising a
30 CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 253, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 254 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 255;

(w) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 256, a CDR2 comprising the amino acid

sequence set forth in SEQ ID NO: 257 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 258; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 259, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 260 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 261;

(x) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 262, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 263 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 264; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 265, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 266 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 267;

(y) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 304, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 305 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 306; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 307, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 308 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 309;

(z) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 316, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 317 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 318; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 319, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 320 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 321;

(aa) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 328, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 329 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 330; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 331, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 332 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 333;

(ab) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO:340, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 341 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 342; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 343, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 344 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 345;

(ac) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 352, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 353 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 354; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 355, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 356 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 357;

(ad) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 364, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 365 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 366; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 367, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 368 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 369;

(ae) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 376, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 377 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 378; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 379, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 380 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 381;or

(af) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 388, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 389 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 390; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 391, a CDR2

comprising the amino acid sequence set forth in SEQ ID NO: 393 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 393

The presently disclosed subject matter further provides a chimeric antigen receptor (CAR), comprising an extracellular antigen-binding domain that binds to a
5 G-protein coupled receptor family C group 5 member D (GPRC5D), a transmembrane domain and an intracellular domain, wherein the extracellular antigen-binding domain comprises:

(a) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:1, and a light
10 chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:2;

(b) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:5, and a light
15 chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:6;

(c) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:9, and a light
chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:10;

(d) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:13, and a light
20 chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:14;

(e) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3
25 of the heavy chain variable region sequence set forth in SEQ ID NO:17, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:18;

(f) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:21, and a light chain
30 variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:22;

(g) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:25, and a light

chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:26;

(h) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:29, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:30;

(i) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:33, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:34;

(j) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:37, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:38;

(k) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:41, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:42;

(l) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:45, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:46;

(m) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:49, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:50;

(n) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:53, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:54;

(o) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:57, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:58;

(p) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:61, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:62;

5 (q) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:65, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:66;

10 (r) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:69, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:70;

15 (s) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:73, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:74;

20 (t) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:77, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:78;

(u) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:81, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:82;

25 (v) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:85, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:86;

30 (w) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:89, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:90;

(x) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:93, and a light

chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:94;

(y) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:302, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:303;

(z) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:314, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:315;

(aa) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:326, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:327;

(ab) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:338, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:339;

(ac) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:350, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:351;

(ad) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:362, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:363;

(ae) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:374, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:375; or

(af) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:386, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:387.

The presently disclosed subject matter further provides an immunoresponsive cell comprising the CAR as described herein.

The presently disclosed subject matter further provides a nucleic acid molecule encoding the chimeric antigen receptor (CAR) as described herein.

- 5 The presently disclosed subject matter further provides a method for producing an immunoresponsive cell that binds to a G-protein coupled receptor family C group 5 member D (GPRC5D), comprising introducing into the immunoresponsive cell a nucleic acid molecule as described herein.

What is claimed is:

1. A chimeric antigen receptor (CAR), comprising an extracellular antigen-binding domain that binds to a G-protein coupled receptor family C group 5 member D (GPC5D), a transmembrane domain and an intracellular domain, wherein the extracellular antigen-binding domain comprises:

(a) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 124, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 125 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 126; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 127, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 128 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 129;

(b) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 130, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 131 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 132; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 133, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 134 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 135;

(c) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 136, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 137 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 138; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 139, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 140 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 141;

(d) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 142, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 143 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 144; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 145, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 146 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 147;

(e) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 148, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 149 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 150; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 151, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 152 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 153;

(f) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 154, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 155 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 156; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 157, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 158 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 159;

(g) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 160, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 161 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 162; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 163, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 164 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 165;

(h) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 166, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 167 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 168; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 169, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 170 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 171;

(i) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 172, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 173 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 174; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 175, a CDR2 comprising the amino acid sequence set forth

in SEQ ID NO: 176 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 177;

(j) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 178, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 179 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 180; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 181, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 182 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 183;

(k) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 184, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 185 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 186; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 187, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 188 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 189;

(l) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 190, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 191 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 192; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 193, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 194 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 195;

(m) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 196, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 197 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 198; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 199, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 200 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 201;

(n) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 202, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 203 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 204; and a light chain variable region comprising a CDR1 comprising the amino acid

sequence set forth in SEQ ID NO: 205, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 206 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 207;

(o) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 208, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 209 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 210; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 211, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 212 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 213;

(p) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 214, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 215 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 216; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 217, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 218 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 219;

(q) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 220, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 221 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 222; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 223, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 224 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 225;

(r) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 226, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 227 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 228; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 229, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 230 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 231;

(s) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 232, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 233 and a CDR3 comprising the amino acid sequence set forth in SEQ ID

NO: 234; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 235, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 236 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 237;

(t) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 238, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 239 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 240; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 241, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 242 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 243;

(u) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 244, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 245 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 246; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 247, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 248 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 249;

(v) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 250, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 251 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 252; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 253, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 254 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 255;

(w) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 256, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 257 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 258; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 259, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 260 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 261;

(x) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 262, a CDR2 comprising the amino acid sequence set forth

in SEQ ID NO: 263 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 264; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 265, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 266 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 267;

(y) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 304, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 305 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 306; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 307, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 308 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 309;

(z) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 316, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 317 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 318; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 319, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 320 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 321;

(aa) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 328, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 329 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 330; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 331, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 332 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 333;

(ab) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 340, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 341 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 342; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 343, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 344 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 345;

(ac) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 352, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 353 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 354; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 355, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 356 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 357;

(ad) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 364, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 365 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 366; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 367, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 368 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 369;

(ae) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 376, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 377 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 378; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 379, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 380 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 381; or

(af) a heavy chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 388, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 389 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 390; and a light chain variable region comprising a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 391, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 393 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 393.

2. A chimeric antigen receptor (CAR), comprising an extracellular antigen-binding domain that binds to a G-protein coupled receptor family C group 5 member D (GPC5D), a transmembrane domain and an intracellular domain, wherein the extracellular antigen-binding domain comprises:

(a) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:1, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:2;

(b) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:5, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:6;

(c) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:9, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:10;

(d) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:13, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:14;

(e) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:17, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:18;

(f) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:21, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:22;

(g) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:25, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:26;

(h) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:29, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:30;

(i) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:33, and a light chain variable

region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:34;

(j) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:37, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:38;

(k) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:41, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:42;

(l) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:45, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:46;

(m) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:49, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:50;

(n) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:53, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:54;

(o) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:57, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:58;

(p) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:61, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:62;

(q) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:65, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:66;

(r) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:69, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:70;

(s) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:73, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:74;

(t) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:77, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:78;

(u) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:81, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:82;

(v) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:85, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:86;

(w) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:89, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:90;

(x) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:93, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:94;

(y) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:302, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:303;

(z) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:314, and a light chain variable

region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:315;

(aa) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:326, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:327;

(ab) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:338, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:339;

(ac) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:350, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:351;

(ad) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:362, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:363;

(ae) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:374, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:375; or

(af) a heavy chain variable region comprising a CDR1, a CDR2, and a CDR3 of the heavy chain variable region sequence set forth in SEQ ID NO:386, and a light chain variable region comprising a CDR1, a CDR2, and a CDR3 of the light chain variable region sequence set forth in SEQ ID NO:387.

3. The CAR of claim 1 or claim 2, wherein the extracellular antigen-binding domain binds to GPRC5D with a binding affinity (K_d) of from 1×10^{-9} M to 3×10^{-6} M.

4. The CAR of any one of claims 1-3, wherein the extracellular antigen-binding domain is a single-chain variable fragment (scFv).

5. The CAR of any one of claims 1-4, wherein the extracellular antigen-binding domain is a single-chain variable fragment (scFv) comprising the amino acid sequence set forth in

any one of SEQ ID NOS: 100, 101, 102, 103, 104, 105, 106, 107, 108, 109, 110, 111, 112, 113, 114, 115, 116, 117, 118, 119, 120, 121, 122, 123, 301, 313, 325, 337, 349, 361, 373, and 385.

6. The CAR of any one of claims 1-4, wherein the extracellular antigen-binding domain is a murine scFv.

7. The CAR of any one of claims 1-5, wherein the extracellular antigen-binding domain is a human scFv.

8. The CAR of any one of claims 1-3, wherein the extracellular antigen-binding domain is a Fab, which is optionally crosslinked.

9. The CAR of any one of claims 1-3, wherein the extracellular antigen-binding domain is a F(ab)₂.

10. The CAR of any one of claims 4-9, wherein one or more of the scFv, the Fab and the F(ab)₂ is comprised in a fusion protein with a heterologous sequence to form the extracellular antigen-binding domain.

11. The CAR of any one of claims 1-10, wherein the heavy chain variable region comprises an amino acid sequence that is at least 90% homologous to an amino acid sequence selected from the group consisting of SEQ ID NOS:1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61, 65, 69, 73, 77, 81, 85, 89, 93, 302, 314, 326, 338, 350, 362, 374, and 386.

12. The CAR of any one of claims 1-11, wherein the heavy chain variable region comprises an amino acid sequence selected from the group consisting of SEQ ID NOS:1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61, 65, 69, 73, 77, 81, 85, 89, 93, 302, 314, 326, 338, 350, 362, 374, and 386, and conservative modifications thereof.

13. The CAR of any one of claims 1-12, wherein the heavy chain variable region comprises the amino acid sequence selected from the group consisting of SEQ ID NOS:1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61, 65, 69, 73, 77, 81, 85, 89, 93, 302, 314, 326, 338, 350, 362, 374, and 386.

14. The CAR of any one of claims 1-13, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:53.
15. The CAR of any one of claims 1-13, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:57.
16. The CAR of any one of claims 1-13, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:61.
17. The CAR of any one of claims 1-13, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:65.
18. The CAR of any one of claims 1-13, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:69.
19. The CAR of any one of claims 1-18, wherein the light chain variable region comprises an amino acid sequence that is at least 90% homologous to an amino acid sequence selected from the group consisting of SEQ ID NOS: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62, 66, 70, 74, 78, 82, 86, 90, 94, 303, 315, 327, 339, 351, 363, 375, and 387.
20. The CAR of any one of claims 1-19, wherein the light chain variable region comprises an amino acid sequence selected from the group consisting of SEQ ID NOS: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62, 66, 70, 74, 78, 82, 86, 90, 94, 303, 315, 327, 339, 351, 363, 375, and 387, and conservative modifications thereof.
21. The CAR of any one of claims 1-20, wherein the light chain variable region comprises the amino acid sequence selected from the group consisting of SEQ ID NOS:2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62, 66, 70, 74, 78, 82, 86, 90, 94, 303, 315, 327, 339, 351, 363, 375, and 387.
22. The CAR of any one of claims 1-21, wherein the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:54.
23. The CAR of any one of claims 1-21, wherein the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:58.

24. The CAR of any one of claims 1-21, wherein the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:62.
25. The CAR of any one of claims 1-21, wherein the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:66.
26. The CAR of any one of claims 1-21, wherein the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:70.
27. The CAR of any one of claims 1-26, wherein (a) the heavy chain variable region comprises an amino acid sequence that is at least 90% homologous to an amino acid sequence selected from the group consisting of SEQ ID NO: 1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61, 65, 69, 73, 77, 81, 85, 89, 93, 302, 314, 326, 338, 350, 362, 374, and 386; and (b) the light chain variable region comprises an amino acid sequence that is at least 90% to an amino acid sequence selected from the group consisting of SEQ ID NOS: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62, 66, 70, 74, 78, 82, 86, 90, 94, 303, 315, 327, 339, 351, 363, 375, and 387.
28. The CAR of any one of claims 1-27, wherein (a) the heavy chain variable region comprises an amino acid sequence selected from the group consisting of SEQ ID NOS:1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61, 65, 69, 73, 77, 81, 85, 89, 93, 302, 314, 326, 338, 350, 362, 374, and 386, and conservative modifications thereof, and (b) the light chain variable region comprises an amino acid sequence selected from the group consisting of SEQ ID NOS: 2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62, 66, 70, 74, 78, 82, 86, 90, 94, 303, 315, 327, 339, 351, 363, 375, and 387, and conservative modifications thereof.
29. The CAR of any one of claims 1-28, wherein (a) the heavy chain variable region comprises the amino acid sequence selected from the group consisting of SEQ ID NOS:1, 5, 9, 13, 17, 21, 25, 29, 33, 37, 41, 45, 49, 53, 57, 61, 65, 69, 73, 77, 81, 85, 89, 93, 302, 314, 326, 338, 350, 362, 374, and 386; and (b) the light chain variable region comprises the amino acid sequence selected from the group consisting of SEQ ID NOS:2, 6, 10, 14, 18, 22, 26, 30, 34, 38, 42, 46, 50, 54, 58, 62, 66, 70, 74, 78, 82, 86, 90, 94, 303, 315, 327, 339, 351, 363, 375, and 387.
30. The CAR of any one of claims 1-29, wherein:

(a) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:1, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:2;

(b) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:5, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:6;

(c) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:9, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:10;

(d) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:13, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:14;

(e) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:17, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:18;

(f) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:21, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:22;

(g) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:25, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:26;

(h) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:29, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:30;

(i) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:33, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:34;

(j) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:37, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:38;

(k) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:41, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:42;

(l) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:45, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:46;

(m) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:49, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:50;

(n) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:53, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:54;

(o) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:57, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:58;

(p) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:61, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:62;

(q) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:65, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:66;

(r) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:69, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:70;

(s) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:73, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:74;

(t) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:77, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:78;

(u) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:81, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:82;

(v) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:85, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:86;

(w) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:89, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:90;

(x) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:93, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:94;

(y) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:302, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:303;

(z) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:314, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:315;

(aa) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:326, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:327;

(ab) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:338, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:339;

(ac) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:350, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:351;

(ad) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:362, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:363;

(ae) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:374, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:375; or

(af) the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:386, and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:387.

31. The CAR of claim 30, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:53; and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:54.

32. The CAR of claim 30, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:57; and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:58.
33. The CAR of claim 30, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:61; and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:62.
34. The CAR of claim 30, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:65; and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:66.
35. The CAR of claim 30, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:69; and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:70.
36. The CAR of any one of claims 1-35, wherein the extracellular antigen-binding domain further comprises a linker between the heavy chain variable region and the light chain variable region.
37. The CAR of any one of claims 1-36, wherein (a) the heavy chain variable region comprises a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 202, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 203 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 204; and (b) the light chain variable region comprises a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 205, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 206 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 207.
38. The CAR of any one of claims 1-36, wherein (a) the heavy chain variable region comprises a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 208, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 209 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 210; and (b) the light chain variable region comprises a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 211, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 212 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 213.

39. The CAR of any one of claims 1-36, wherein (a) the heavy chain variable region comprises a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 214, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 215 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 216; and (b) the light chain variable region comprises a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 217, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 218 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 219.
40. The CAR of any one of claims 1-36, wherein (a) the heavy chain variable region comprises a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 220, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 221 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 222; and (b) the light chain variable region comprises a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 223, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 224 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 225.
41. The CAR of any one of claims 1-36, wherein (a) the heavy chain variable region comprises a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 226, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 227 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 228; and (b) the light chain variable region comprises a CDR1 comprising the amino acid sequence set forth in SEQ ID NO: 229, a CDR2 comprising the amino acid sequence set forth in SEQ ID NO: 230 and a CDR3 comprising the amino acid sequence set forth in SEQ ID NO: 231.
42. The CAR of any one of claims 1-41, wherein a signal peptide is covalently joined to the 5' terminus of the extracellular antigen-binding domain.
43. The CAR of any one of claims 1-42, wherein the GPRC5D comprises the amino acid sequence set forth in SEQ ID NO:97.
44. The CAR of claim 43, wherein the extracellular antigen-binding domain binds to one, two, three or four epitope region selected from the group consisting of an epitope region in N-terminal region comprising amino acids 1-27 of SEQ ID NO:97, an epitope region in ECL1 region comprising amino acids 85-93 of SEQ ID NO:97, an epitope region in ECL2 region comprising amino acids 145-167 of SEQ ID NO:97, and an epitope region in ECL3 region comprising amino acids 226-239 of SEQ ID NO:97.

45. The CAR of claim 44, wherein the extracellular antigen-binding domain binds to an epitope region comprising amino acids 16-23 of SEQ ID NO:97.
46. The CAR of claim 45, wherein the extracellular antigen-binding domain binds to an epitope region comprising amino acids 15-23 of SEQ ID NO:97.
47. The CAR of claim 45, wherein the extracellular antigen-binding domain binds to an epitope region comprising amino acids 16-25 of SEQ ID NO:97.
48. The CAR of claim 44, wherein the extracellular antigen-binding domain binds to an epitope region comprising amino acids 10-17 of SEQ ID NO:97.
49. The CAR of claim 48, wherein the extracellular antigen-binding domain binds to an epitope region comprising amino acids 5-17 of SEQ ID NO:97.
50. The CAR of claim 44, wherein the extracellular antigen-binding domain binds to an epitope region comprising amino acids 85-95 of SEQ ID NO:97.
51. The CAR of claim 44, wherein the extracellular antigen-binding domain binds to an epitope region comprising amino acids 157-164 of SEQ ID NO:97.
52. The CAR of claim 51, wherein the extracellular antigen-binding domain binds to an epitope region comprising amino acids 157-167 of SEQ ID NO:97.
53. The CAR of claim 44, wherein the extracellular antigen-binding domain binds to an epitope region comprising amino acids 230-237 of SEQ ID NO:97.
54. The CAR of claim 53, wherein the extracellular antigen-binding domain binds to an epitope region comprising amino acids 229-237 of SEQ ID NO:97.
55. The CAR of claim 53, wherein the extracellular antigen-binding domain binds to an epitope region comprising amino acids 230-243 of SEQ ID NO:97.
56. The CAR of claim 53, wherein the extracellular antigen-binding domain binds to an epitope region comprising amino acids 227-237 of SEQ ID NO:97.
57. The CAR of claim 44, wherein the extracellular antigen-binding domain binds to one, two or three epitope region selected from the group consisting of an epitope region comprising amino acids 16-25 of SEQ ID NO:97, an epitope region comprising amino acids

157-164 of SEQ ID NO:97, and an epitope region comprising amino acids 229-237 of SEQ ID NO:97.

58. The CAR of claim 57, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:57 and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:58.

59. The CAR of claim 57 or 58, wherein (a) the heavy chain variable region comprises the amino acid sequences set forth in SEQ ID NOs: 208, 209 and 210; and (b) the light chain variable region comprises the amino acid sequences set forth in SEQ ID NOs: 211, 212 and 213.

60. The CAR of claim 44, wherein the extracellular antigen-binding domain binds to one, two or three epitope region selected from the group consisting of an epitope region comprising amino acids 5-17 of SEQ ID NO:97, an epitope region comprising amino acids 85-95 of SEQ ID NO:97, and an epitope region comprising amino acids 157-164 of SEQ ID NO:97.

61. The CAR of claim 60, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:61 and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:62.

62. The CAR of claim 60 or 61, wherein (a) the heavy chain variable region comprises the amino acid sequences set forth in SEQ ID NOs: 214, 215 and 216; and (b) the light chain variable region comprises the amino acid sequences set forth in SEQ ID NOs: 217, 218 and 219.

63. The CAR of claim 44, wherein the extracellular antigen-binding domain binds to one or two epitope region selected from the group consisting of an epitope region comprising amino acids 15-23 of SEQ ID NO:97, and an epitope region comprising amino acids 230-243 of SEQ ID NO:97.

64. The CAR of claim 63, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:65 and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:66.

65. The CAR of claim 63 or 64, wherein (a) the heavy chain variable region comprises the amino acid sequences set forth in SEQ ID NOs: 220, 221 and 222; and (b) the light chain variable region comprises the amino acid sequences set forth in SEQ ID NOs: 223, 224 and 225.

66. The CAR of claim 44, wherein the extracellular antigen-binding domain binds to one, two or three epitope region selected from the group consisting of an epitope region comprising amino acids 10-17 of SEQ ID NO:97, an epitope region comprising amino acids 157-167 of SEQ ID NO:97, and an epitope region comprising amino acids 227-237 of SEQ ID NO:97.

67. The CAR of claim 66, wherein the heavy chain variable region comprises the amino acid sequence set forth in SEQ ID NO:69 and the light chain variable region comprises the amino acid sequence set forth in SEQ ID NO:70.

68. The CAR of claim 66 or 67, wherein (a) the heavy chain variable region comprises the amino acid sequences set forth in SEQ ID NOs: 226, 227 and 228; and (b) the light chain variable region comprises the amino acid sequences set forth in SEQ ID NOs: 229, 230 and 231.

69. The CAR of any one of claims 1-68, wherein the transmembrane domain comprises a CD8 polypeptide, a CD28 polypeptide, a CD3 ζ polypeptide, a CD4 polypeptide, a 4-1BB polypeptide, an OX40 polypeptide, an ICOS polypeptide, a CTLA-4 polypeptide, a PD-1 polypeptide, a LAG-3 polypeptide, a 2B4 polypeptide, a BTLA polypeptide, or a combination thereof.

70. The CAR of claim 69, wherein the transmembrane domain comprises a CD8 polypeptide.

71. The CAR of claim 69, wherein the transmembrane domain comprises a CD28 polypeptide.

72. The CAR of any one of claims 1-71, wherein the intracellular domain comprises a CD3 ζ polypeptide.

73. The CAR of any one of claims 1-72, wherein the intracellular domain further comprises at least one signaling region.

74. The CAR of claim 73, wherein the at least one signaling region comprises a CD28 polypeptide, a 4-1BB polypeptide, an OX40 polypeptide, an ICOS polypeptide, a DAP-10 polypeptide, a PD-1 polypeptide, a CTLA-4 polypeptide, a LAG-3 polypeptide, a 2B4 polypeptide, a BTLA polypeptide, or a combination thereof.
75. The CAR of claim 73 or 74, wherein the at least one signaling region is a co-stimulatory signaling region.
76. The CAR of claim 75, wherein the at least one co-stimulatory signaling region comprises a CD28 polypeptide, a 4-1BB polypeptide, an OX40 polypeptide, an ICOS polypeptide, a DAP-10 polypeptide, or a combination thereof.
77. The CAR of claim 76, wherein the at least one co-stimulatory signaling region comprises a CD28 polypeptide.
78. The CAR of claim 76, wherein the at least one co-stimulatory signaling region comprises a 4-1BB polypeptide.
79. The CAR of any one of claims 73-77, wherein the transmembrane domain comprises a CD28 polypeptide, and the intracellular domain comprises a CD3 ζ polypeptide and at least one signaling region that comprises a CD28 polypeptide.
80. The CAR of any one of claims 73-76 and 78, wherein the transmembrane domain comprises a CD8 polypeptide, and the intracellular domain comprises a CD3 ζ polypeptide and at least one signaling region that comprises a 4-1BB polypeptide.
81. The CAR of any one of claims 73-76 and 78, wherein the transmembrane domain comprises a CD28 polypeptide, and the intracellular domain comprises a CD3 ζ polypeptide and at least one signaling region that comprises a 4-1BB polypeptide.
82. The CAR of any one of claims 1-81, wherein the CAR is recombinantly expressed.
83. The CAR of any one of claims 1-82, wherein the CAR is expressed from a vector.
84. The CAR of claim 83, wherein the vector is a γ -retroviral vector.
85. The CAR of claim 83, wherein the vector is a lentiviral vector.
86. An immunoresponsive cell comprising the CAR of any one of claims 1-85.

87. The immunoresponsive cell of claim 86, wherein the immunoresponsive cell is transduced with the CAR.
88. The immunoresponsive cell of claim 86 or 87, wherein the CAR is constitutively expressed on the surface of the immunoresponsive cell.
89. The immunoresponsive cell of any one of claims 86-88, wherein the immunoresponsive cell is further transduced with at least one co-stimulatory ligand such that the immunoresponsive cell expresses the at least one co-stimulatory ligand.
90. The immunoresponsive cell of claim 89, wherein the at least one co-stimulatory ligand is selected from the group consisting of 4-1BBL, CD80, CD86, CD70, OX40L, CD48, TNFRSF14, and combinations thereof.
91. The immunoresponsive cell of any one of claims 86-90, wherein the immunoresponsive cell is further transduced with at least one cytokine such that the immunoresponsive cell secretes the at least one cytokine.
92. The immunoresponsive cell of claim 91, wherein the at least one cytokine is selected from the group consisting of IL-2, IL-3, IL-6, IL-7, IL-11, IL-12, IL-15, IL-17, IL-21, and combinations thereof.
93. The immunoresponsive cell of any one of claims 86-92, wherein the immunoresponsive cell is selected from the group consisting of a T cell, a Natural Killer (NK) cell, a cytotoxic T lymphocyte (CTL), a regulatory T cell, a human embryonic stem cell, a lymphoid progenitor cell, a T cell-precursor cell, and a pluripotent stem cell from which lymphoid cells may be differentiated.
94. The immunoresponsive cell of claim 93, wherein the immunoresponsive cell is a T cell.
95. A nucleic acid molecule encoding the chimeric antigen receptor (CAR) of any one of claims 1-85.
96. The nucleic acid molecule of claim 95, comprising the nucleotide sequence set forth in SEQ ID NO:397.

97. The nucleic acid molecule of claim 95, comprising the nucleotide sequence set forth in SEQ ID NO:398.
98. The nucleic acid molecule of claim 95, comprising the nucleotide sequence set forth in SEQ ID NO:399.
99. The nucleic acid molecule of claim 95, comprising the nucleotide sequence set forth in SEQ ID NO:400.
100. The nucleic acid molecule of claim 95, comprising the nucleotide sequence set forth in SEQ ID NO:401.
101. The nucleic acid molecule of claim 95, comprising the nucleotide sequence set forth in SEQ ID NO:402.
102. The nucleic acid molecule of claim 95, comprising the nucleotide sequence set forth in SEQ ID NO:403.
103. The nucleic acid molecule of claim 95, comprising the nucleotide sequence set forth in SEQ ID NO:406.
104. The nucleic acid molecule of claim 95, comprising the nucleotide sequence set forth in SEQ ID NO:407.
105. The nucleic acid molecule of claim 95, comprising the nucleotide sequence set forth in SEQ ID NO:408.
106. A vector comprising the nucleic acid molecule of any one of claims 95-105.
107. The vector of claim 106, wherein the vector is a γ -retroviral vector.
108. The vector of claim 106, wherein the vector is a lentiviral vector.
109. A host cell expressing the nucleic acid molecule of any one of claims 95-105.
110. The host cell of claim 109, wherein the host cell is a T cell.

111. Use of an effective amount of the immunoresponsive cell of any one of claims 86-94 in the manufacture of a medicament for reducing tumor burden in a subject with multiple myeloma.
112. The use of claim 111, wherein the immunoresponsive cell reduces the number of tumor cells.
113. The use of claim 111, wherein the immunoresponsive cell reduces tumor size.
114. The use of claim 111, wherein the immunoresponsive cell eradicates the tumor in the subject.
115. The use of any one of claims 111-114, wherein the subject is a human.
116. The use of any one of claims 111-115, wherein the immunoresponsive cell is a T cell.
117. Use of an effective amount of the immunoresponsive cell of any one of claims 86-94 in the manufacture of a medicament for increasing or lengthening survival of a subject having multiple myeloma.
118. The use of claim 117, wherein the immunoresponsive cell reduces or eradicates tumor burden in the subject.
119. A method for producing an immunoresponsive cell that binds to a G-protein coupled receptor family C group 5 member D (GPRC5D), comprising introducing into the immunoresponsive cell a nucleic acid molecule of any one of claims 95-105.
120. A pharmaceutical composition comprising an effective amount of the immunoresponsive cell of any one of claims 86-94 and a pharmaceutically acceptable excipient.
121. The pharmaceutical composition of claim 120, wherein the pharmaceutical composition is for treating a neoplasia.
122. The pharmaceutical composition of claim 121, wherein the neoplasia is multiple myeloma or Waldenstrom's Macroglobulinemia.
123. The pharmaceutical composition of claim 122, wherein the neoplasia is multiple myeloma.

124. A kit for treating a neoplasia, comprising the immunoresponsive cell of any one of claims 86-94.

125. The kit of claim 124, wherein the kit further comprises written instructions for using the immunoresponsive cell for treating a subject having a neoplasia.

126. The kit of claim 124 or 125, wherein the neoplasia is multiple myeloma or Waldenstrom's Macroglobulinemia.

127. The kit of claim 126, wherein the neoplasia is multiple myeloma.