CLAIMS

1.A multispecific antibody or antigen-binding fragment thereof, comprising a first antigen binding domain that specifically binds to human CEA at amino acids 596 to 674 of SEQ ID NO: 88 and a second antigen binding domain that specifically binds to human CD137.

2. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein the first antigen binding domain does not bind to other CEACAM family members.

3. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein the first antigen binding domain that specifically binds to human CEA comprises:

(i) a heavy chain variable region (VH) that comprises (a) a Heavy Chain Complementarity Determining Region (HCDR1) 1 of SEQ ID NO: 7, (b) a HCDR2 of SEQ ID NO: 8, and (c) a HCDR3 of SEQ ID NO: 9; and a light chain variable region (VL) that comprises: (d) a Light Chain Complementarity Determining Region (LCDR1) 1 of SEQ ID NO: 10, (e) a LCDR2 of SEQ ID NO: 11, and (f) a LCDR3 of SEQ ID NO: 6;

(ii) a VH that comprises (a) a HCDR1 of SEQ ID NO: 24, (b) a HCDR2 of SEQ ID NO: 25, and (c) a HCDR3 of SEQ ID NO: 26; and a VL that comprises: (d) a LCDR1 of SEQ ID NO: 27, (e) a LCDR2 of SEQ ID NO: 28, and (f) a LCDR3 of SEQ ID NO: 23; or
(iii) a VH that comprises (a) a HCDR1 of SEQ ID NO: 41, (b) a HCDR2 of SEQ ID NO: 42, and (c) a HCDR3 of SEQ ID NO: 43; and a VL that comprises: (d) a LCDR1 of SEQ ID NO: 44, (e) a LCDR2 of SEQ ID NO: 45, and (f) a LCDR3 of SEQ ID NO: 40.

4. The multispecific antibody or antigen-binding fragment thereof of claim 3, wherein the first antigen binding domain that specifically binds to human CEA comprises:

(i) a VH comprising an amino acid sequence at least 90, 91, 92, 93, 94, 95, 96, 97, 98 or 99% identical to SEQ ID NO:14, and a VL comprising an amino acid sequence at least 90, 91, 92, 93, 94, 95, 96, 97, 98 or 99% identical to SEQ ID NO: 15;

(ii) a VH comprising an amino acid sequence at least 90, 91, 92, 93, 94, 95, 96, 97, 98 or 99% identical to SEQ ID NO: 31, and a VL comprising an amino acid sequence at least 90, 91, 92, 93, 94, 95, 96, 97, 98 or 99% identical to SEQ ID NO: 32; or

(iii) a VH comprising an amino acid sequence at least 90, 91, 92, 93, 94, 95, 96, 97, 98 or 99% identical to SEQ ID NO: 48, and a VL comprising an amino acid sequence at least 90, 91, 92, 93, 94, 95, 96, 97, 98 or 99% identical to SEQ ID NO: 49.

5. The multispecific antibody or antigen-binding fragment thereof of claim 4, wherein one, two, three, four, five, six, seven, eight, nine, or ten amino acids within SEQ ID NO:14, 15, 31, 32, 48, or 49 have been inserted, deleted or substituted.

6. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein the first antigen binding domain that specifically binds to human CEA comprises:

(i) a VH that comprises SEQ ID NO: 14, and a VL that comprises SEQ ID NO: 15;

(ii) a VH that comprises SEQ ID NO: 31, and a VL that comprises SEQ ID NO: 32; or

(iii) a VH that comprises SEQ ID NO: 48, and a VL that comprises SEQ ID NO: 49.

7. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein the second antigen binding domain that specifically binds to human CD137 comprises:

(i) a VH that comprises (a) a HCDR1 of SEQ ID NO: 65, (b) a HCDR2 of SEQ ID NO: 80, and (c) a HCDR3 of SEQ ID NO: 81;

(ii) a VH that comprises (a) a HCDR1 of SEQ ID NO: 65, (b) a HCDR2 of SEQ ID NO: 73, and (c) a HCDR3 of SEQ ID NO: 67;

(iii) a VH that comprises (a) a HCDR1 of SEQ ID NO: 65, (b) a HCDR2 of SEQ ID NO: 66, and (c) a HCDR3 of SEQ ID NO: 67; or

(iv) a VH that comprises (a) a HCDR1 of SEQ ID NO: 55, (b) a HCDR2 of SEQ ID NO: 56, and (c) a HCDR3 of SEQ ID NO: 57.

8. The multispecific antibody or antigen-binding fragment thereof of claim 7, wherein the second antigen binding domain that specifically binds to human CD137 comprises:

(i) a VH comprising an amino acid sequence at least 90, 91, 92, 93, 94, 95, 96, 97, 98 or 99% identical to SEQ ID NO: 84;

(ii) a VH comprising an amino acid sequence at least 90, 91, 92, 93, 94, 95, 96, 97, 98 or 99% identical to SEQ ID NO: 86;

(iii) a VH comprising an amino acid sequence at least 90, 91, 92, 93, 94, 95, 96, 97, 98 or 99% identical to SEQ ID NO: 75;

(iv) a VH comprising an amino acid sequence at least 90, 91, 92, 93, 94, 95, 96, 97, 98 or 99% identical to SEQ ID NO: 70; or

(v) a VH comprising an amino acid sequence at least 90, 91, 92, 93, 94, 95, 96, 97, 98 or 99% identical to SEQ ID NO: 60.

9. The multispecific antibody or antigen-binding fragment thereof of claim 8, wherein one, two, three, four, five, six, seven, eight, nine, or ten amino acids within SEQ ID NO:84, 86, 75, 70, or 60 have been inserted, deleted or substituted.

10. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein the second antigen binding domain that specifically binds to human CD137 comprises:

(i) a VH that comprises SEQ ID NO: 84;

(ii) a VH that comprises SEQ ID NO: 86;

(iii) a VH that comprises SEQ ID NO: 75;

(iv) a VH that comprises SEQ ID NO: 70; or

(v) a VH that comprises SEQ ID NO: 60.

11. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein:

(i) the first antigen binding domain that specifically binds to human CEA comprises: a VH that comprises (a) a HCDR1 of SEQ ID NO: 7, (b) a HCDR2 of SEQ ID NO: 8, and (c) a HCDR3 of SEQ ID NO: 9; and a VL that comprises: (d) a LCDR1 of SEQ ID NO: 10, (e) a LCDR2 of SEQ ID NO: 11, and (f) a LCDR3 of SEQ ID NO: 6; and the second antigen binding domain that specifically binds to human CD137 comprises: a VH that comprises (a) a HCDR1 of SEQ ID NO: 65, (b) a HCDR2 of SEQ ID NO: 80, and (c) a HCDR3 of SEQ ID NO: 81 and;

(ii) the first antigen binding domain that specifically binds to human CEA comprises: a VH that comprises (a) a HCDR1 of SEQ ID NO: 7, (b) a HCDR2 of SEQ ID NO: 8, and (c) a HCDR3 of SEQ ID NO: 9; and a VL that comprises: (d) a LCDR1 of SEQ ID NO: 10, (e) a LCDR2 of SEQ ID NO: 11, and (f) a LCDR3 of SEQ ID NO: 6; and the second antigen binding domain that specifically binds to human CD137 comprises: a VH that comprises (a) a HCDR1 of SEQ ID NO: 65, (b) a HCDR2 of SEQ ID NO:73, and (c) a HCDR3 of SEQ ID NO: 67;

(iii) the first antigen binding domain that specifically binds to human CEA comprises: a VH that comprises (a) a HCDR1 of SEQ ID NO: 7, (b) a HCDR2 of SEQ ID NO: 8, and (c) a

HCDR3 of SEQ ID NO: 9; and a VL that comprises: (d) a LCDR1 of SEQ ID NO: 10, (e) a LCDR2 of SEQ ID NO: 11, and (f) a LCDR3 of SEQ ID NO: 6; and the second antigen binding domain that specifically binds to human CD137 comprises: a VH that comprises (a) a HCDR1 of SEQ ID NO: 65, (b) a HCDR2 of SEQ ID NO: 66, and (c) a HCDR3 of SEQ ID NO: 67; or

(iv) the first antigen binding domain that specifically binds to human CEA comprises: a VH that comprises (a) a HCDR1 of SEQ ID NO: 7, (b) a HCDR2 of SEQ ID NO: 8, and (c) a HCDR3 of SEQ ID NO: 9 and a VL that comprises: (d) a LCDR1 of SEQ ID NO: 10, (e) a LCDR2 of SEQ ID NO: 11, and (f) a LCDR3 of SEQ ID NO: 6; and the second antigen binding domain that specifically binds to human CD137 comprises: a VH that comprises (a) a HCDR1 of SEQ ID NO: 55, (b) a HCDR2 of SEQ ID NO: 56, and (c) a HCDR3 of SEQ ID NO: 57.

12. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein:

(i) the first antigen binding domain that specifically binds to human CEA comprises: a VH that comprises SEQ ID NO: 14, and a VL that comprises SEQ ID NO: 15; and the second antigen binding domain that specifically binds to human CD137 comprises: a VH that comprises SEQ ID NO: 84;

(ii) the first antigen binding domain that specifically binds to human CEA comprises: a VH that comprises SEQ ID NO: 14, and a VL) that comprises SEQ ID NO: 15; and the second antigen binding domain that specifically binds to human CD137 comprises: a VH that comprises SEQ ID NO: 86;

(iii) the first antigen binding domain that specifically binds to human CEA comprises: a VH that comprises SEQ ID NO: 14, and a VL that comprises SEQ ID NO: 15; and the second antigen binding domain that specifically binds to human CD137 comprises: a VH that comprises SEQ ID NO: 75;

(iv) the first antigen binding domain that specifically binds to human CEA comprises: a VH that comprises SEQ ID NO: 14, and a VL that comprises SEQ ID NO: 15; and the second antigen binding domain that specifically binds to human CD137 comprises: a VH that comprises SEQ ID NO: 70; or

(v) the first antigen binding domain that specifically binds to human CEA comprises: a VH that comprises SEQ ID NO: 14, and a VL that comprises SEQ ID NO: 15; and the second antigen binding domain that specifically binds to human CD137 comprises: a VH that comprises SEQ ID NO: 60.

13. The multispecific antibody or antigen-binding fragment thereof of any one of claims 1 to 12 which is a monoclonal antibody, a chimeric antibody, a humanized antibody, a human engineered antibody, a single chain antibody (scFv), a Fab fragment, a Fab' fragment, or a $F(ab')_2$ fragment.

14. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein the multispecific antibody is a bispecific antibody.

15. The bispecific antibody of claim 14, wherein the bispecific antibody comprises a linker comprising the amino acid sequence of any one of SEQ ID NO: 317 to SEQ ID NO: 358.

16. The bispecific antibody of claim 15, wherein the linker comprises the amino acid sequence of SEQ ID NO: 324.

17. The bispecific antibody of claim 15, wherein the linker comprises the amino acid sequence of SEQ ID NO: 329.

18. The bispecific antibody of claim 14, wherein the bispecific antibody is BE-146 (SEQ ID NO: 313 and SEQ ID NO: 179).

19. The bispecific antibody of claim 14, wherein the bispecific antibody is BE-189 (SEQ ID NO: 255 and SEQ ID NO: 179).

20. The bispecific antibody of claim 14, wherein the bispecific antibody is BE-718 (SEQ ID NO: 295 and SEQ ID NO: 179).

21. The bispecific antibody of claim 14, wherein the bispecific antibody is BE-740 (SEQ ID NO: 297 and SEQ ID NO: 179).

22. The bispecific antibody of claim 14, wherein the bispecific antibody is BE-942 (SEQ ID NO: 299, SEQ ID NO: 301 and SEQ ID NO: 303).

23. The bispecific antibody of claim 14, wherein the bispecific antibody is BE-755 (SEQ ID NO: 299, SEQ ID NO: 301 and SEQ ID NO: 305).

24. The bispecific antibody of claim 14, wherein the bispecific antibody is BE-562 (SEQ ID NO: 307 and SEQ ID NO: 179).

25. The bispecific antibody of claim 14, wherein the bispecific antibody is BE-375 (SEQ ID NO: 309 and SEQ ID NO: 179).

26. The bispecific antibody of claim 14, wherein the bispecific antibody is BE-244 (SEQ ID NO: 311 and SEQ ID NO: 179).

27. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein the antibody or antigen-binding fragment thereof has at least one of antibody dependent cellular cytotoxicity (ADCC) and complement dependent cytotoxicity (CDC).

28. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein the antibody or antigen-binding fragment thereof has reduced glycosylation or no glycosylation or is hypofucosylated.

29. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein the antibody or antigen-binding fragment thereof comprises increased bisecting GlcNac structures.

30. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein the Fc domain is an IgG1 with reduced effector function.

31. The multispecific antibody or antigen-binding fragment thereof of claim 1, wherein the Fc domain is an IgG4.

32. A pharmaceutical composition comprising the multispecific antibody or antigen-binding fragment thereof of claim 1 and a pharmaceutically acceptable carrier.

33. The pharmaceutical composition of claim 32, comprising histidine/histidine HCl, trehalose dihydrate, and polysorbate 20.

34. Use of a multispecific antibody or antigen-binding fragment thereof in the manufacture of a medicament for cancer treatment, the multispecific antibody or antigen-binding fragment comprising a first antigen binding domain that specifically binds to human CEA at amino acids

596 to 674 of SEQ ID NO: 88 and a second antigen binding domain that specifically binds to human CD137, and the treatment comprising administering to a subject an effective amount of the multispecific antibody or antigen-binding fragment thereof of claim 1.

35. The use of claim 34, wherein the cancer is gastric cancer, colon cancer, pancreatic cancer, breast cancer, head and neck cancer, kidney cancer, liver cancer, lung cancer, small cell lung cancer, non-small cell lung cancer, ovarian cancer, skin cancer, mesothelioma, lymphoma, leukemia, myeloma or sarcoma.

36. The use of claim 35, wherein the cancer is colon cancer, and the colon cancer is colorectal cancer.

37. The use of claim 35, wherein the cancer is gastric cancer, and the gastric cancer is associated with high CEA levels in the serum.

38. The use of claim 35, wherein the cancer is lung cancer, and the lung cancer is associated with high CEA levels in the serum.

39. The use of claim 35, wherein the cancer is non-small cell lung cancer, and the non-small cell lung cancer is associated with high CEA levels in the serum.

40. The use of claim 34, wherein the multispecific antibody or antigen-binding fragment thereof is to be administered at a range of 5mg-1200 mg.

41. The use of claim 40, wherein the multispecific antibody or antigen-binding fragment thereof is to be administered once per week.

42. The use of claim 34, wherein the multispecific antibody or antigen-binding fragment thereof is to be administered in combination with another therapeutic agent.

43. The use of claim 42, wherein the therapeutic agent is paclitaxel or a paclitaxel agent, docetaxel, carboplatin, topotecan, cisplatin, irinotecan, doxorubicin, lenalidomide or 5-azacytidine.

44. The use of claim 43, wherein the therapeutic agent is a paclitaxel agent, lenalidomide or 5-azacytidine.

45. The use of claim 42, wherein the therapeutic agent an anti-PD1 or anti-PDL1 antibody.

46. The use of claim 45, wherein the anti-PD1 antibody is Tislelizumab.

47. An isolated nucleic acid that encodes the multispecific antibody or antigen-binding fragment thereof of claim 1.

48. A vector comprising the nucleic acid of claim 47.

49. A host cell comprising the nucleic acid of claim 47 or the vector of claim 48.

50. A process for producing a multispecific antibody or antigen-binding fragment thereof comprising cultivating the host cell of claim 49 and recovering the multispecific antibody or antigen-binding fragment thereof from the culture.