WHAT IS CLAIMED IS:

1. An antibody or antigen-binding fragment thereof that binds to MUC1 (The transmembrane glycoprotein Mucin 1) comprising:

a heavy chain variable region (VH) comprising complementarity determining regions (CDRs) 1, 2, and 3, wherein the VH CDR1 region comprises an amino acid sequence that is at least 80% identical to a selected VH CDR1 amino acid sequence, the VH CDR2 region comprises an amino acid sequence that is at least 80% identical to a selected VH CDR2 amino acid sequence, and the VH CDR3 region comprises an amino acid sequence that is at least 80% identical to a selected VH CDR3 amino acid sequence; and

a light chain variable region (VL) comprising CDRs 1, 2, and 3, wherein the VL CDR1 region comprises an amino acid sequence that is at least 80% identical to a selected VL CDR1 amino acid sequence, the VL CDR2 region comprises an amino acid sequence that is at least 80% identical to a selected VL CDR2 amino acid sequence, and the VL CDR3 region comprises an amino acid sequence that is at least 80% identical to a selected VL CDR3 amino acid sequence,

wherein the selected VH CDRs 1, 2, and 3 amino acid sequences and the selected VL CDRs, 1, 2, and 3 amino acid sequences are one of the following:

(1) (1-a) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 7-9, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 1-3, respectively; or, (1-b) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 28-30, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 22-24, respectively;

(2) (2-a) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 7, 63, 9, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 1-3, respectively; or, (2-b) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 28, 65, 30, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 22-24, respectively; and

(3) (3-a) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 7, 64, 9, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 1-3, respectively; or, (3-b) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 28, 66, 30, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 22-24, respectively;

(4) (4-a) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 4-6, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 1-3, respectively; or, (4-b) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 25-27, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 22-24, respectively;

(5) (5-a) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 10-12, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 1-3, respectively; or, (5-b) the selected VH CDRs 1, 2, 3 amino acid sequences are

set forth in SEQ ID NOs: 31-33, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 22-24, respectively;

(6) (6-a) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 13-15, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 1-3, respectively; or, (6-b) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 34-36, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 22-24, respectively;

(7) (7-a) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 16-18, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 1-3, respectively; or, (7-b) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 37-39, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 22-24, respectively; and

(8) (8-a) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 19-21, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 1-3, respectively; or, (8-b) the selected VH CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 40-42, respectively, and the selected VL CDRs 1, 2, 3 amino acid sequences are set forth in SEQ ID NOs: 22-24, respectively.

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

(1) (1-a) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 7-9, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 1-3, respectively, according to Kabat definition; or (1-b) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 28-30, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 22-24, respectively, according to Chothia definition;

(2) (2-a) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 7, 63, 9, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 1-3, respectively, according to Kabat definition; or, (2-b) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 28, 65, 30, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 22-24, respectively, according to Chothia definition;

(3) (3-a) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 7, 64, 9, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 1-3, respectively, according to Kabat definition; or, (3-b) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 28, 66, 30, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 22-24, respectively, according to Chothia definition;

(4) (4-a) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 4-6, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 1-3, respectively, according to Kabat definition; or, (4-b) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 25-27,

respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 22-24, respectively, according to Chothia definition;

(5) (5-a) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 10-12, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 1-3, respectively, according to Kabat definition; or, (5-b) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 31-33, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 22-24, respectively, according to Chothia definition;

(6) (6-a) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 13-15, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 1-3, respectively, according to Kabat definition; or, (6-b) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 34-36, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 22-24, respectively, according to Chothia definition;

(7) (7-a) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 16-18, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 1-3, respectively, according to Kabat definition; or, (7-b) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 37-39, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 22-24, respectively, according to Chothia definition; or

(8) (8-a) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 19-21, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 1-3, respectively, according to Kabat definition; or, (8-b) the VH comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 40-42, respectively, and the VL comprises CDRs 1, 2, 3 with the amino acid sequences set forth in SEQ ID NOs: 22-24, respectively, according to Chothia definition.

3. A nucleic acid comprising a polynucleotide encoding a polypeptide comprising:
   (1) an immunoglobulin heavy chain or a fragment thereof comprising a heavy chain variable region (VH) comprising complementarity determining regions (CDRs) 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 7-9; or SEQ ID NOs: 28-30, respectively, and wherein the VH, when paired with a light chain variable region (VL) comprising the amino acid sequence set forth in SEQ ID NO: 43 binds to MUC1;
   (2) an immunoglobulin light chain or a fragment thereof comprising a VL comprising complementarity determining regions (CDRs) 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 1-3; or SEQ ID NO: 22-24, respectively, and wherein the VL, when paired with a VH comprising the amino acid sequence set forth in SEQ ID NO: 45 binds to MUC1;
   (3) an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising complementarity determining regions (CDRs) 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 7, 63, 9; or SEQ ID NOs: 28, 65, 30, respectively,

and wherein the VH, when paired with a light chain variable region (VL) comprising the amino acid sequence set forth in SEQ ID NO: 43 binds to MUC1;

(4) an immunoglobulin light chain or a fragment thereof comprising a VL comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 1-3; or SEQ ID NO: 22-24, respectively, and wherein the VL, when paired with a VH comprising the amino acid sequence set forth in SEQ ID NO: 61 binds to MUC1；

(5) an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising complementarity determining regions (CDRs) 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 7, 64, 9; or SEQ ID NOs: 28, 66, 30, respectively, and wherein the VH, when paired with a light chain variable region (VL) comprising the amino acid sequence set forth in SEQ ID NO: 43 binds to MUC1; or

(6) an immunoglobulin light chain or a fragment thereof comprising a VL comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 1-3; or SEQ ID NOs: 22-24, respectively, and wherein the VL, when paired with a VH comprising the amino acid sequence set forth in SEQ ID NO: 62 binds to MUC1;

(7) an immunoglobulin heavy chain or a fragment thereof comprising a heavy chain variable region (VH) comprising complementarity determining regions (CDRs) 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 4-6; or SEQ ID NOs: 25-27, respectively, and wherein the VH, when paired with a light chain variable region (VL) comprising the amino acid sequence set forth in SEQ ID NO: 43 binds to MUC1;

(8) an immunoglobulin light chain or a fragment thereof comprising a VL comprising complementarity determining regions (CDRs) 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 1-3; or SEQ ID NO: 22-24, respectively, and wherein the VL, when paired with a VH comprising the amino acid sequence set forth in SEQ ID NO: 44 binds to MUC1;

(9) an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising complementarity determining regions (CDRs) 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 10-12; or SEQ ID NOs: 31-33, respectively, and wherein the VH, when paired with a light chain variable region (VL) comprising the amino acid sequence set forth in SEQ ID NO: 43 binds to MUC1;

(10) an immunoglobulin light chain or a fragment thereof comprising a VL comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 1-3; or SEQ ID NOs: 22-24, respectively, and wherein the VL, when paired with a VH comprising the amino acid sequence set forth in SEQ ID NO: 46 binds to MUC1;

(11) an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising complementarity determining regions (CDRs) 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 13-15; or SEQ ID NOs: 34-36, respectively, and wherein the VH, when paired with a light chain variable region (VL) comprising the amino acid sequence set forth in SEQ ID NO: 43 binds to MUC1;

(12) an immunoglobulin light chain or a fragment thereof comprising a VL comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 1-3; or

SEQ ID NOs: 22-24, respectively, and wherein the VL, when paired with a VH comprising the amino acid sequence set forth in SEQ ID NO: 47 binds to MUC1;

(13) an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising complementarity determining regions (CDRs) 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 16-18; or SEQ ID NOs: 37-39, respectively, and wherein the VH, when paired with a light chain variable region (VL) comprising the amino acid sequence set forth in SEQ ID NO: 43 binds to MUC1;

(14) an immunoglobulin light chain or a fragment thereof comprising a VL comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 1-3; or SEQ ID NOs: 22-24, respectively, and wherein the VL, when paired with a VH comprising the amino acid sequence set forth in SEQ ID NO: 48 binds to MUC1;

(15) an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising complementarity determining regions (CDRs) 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 19-21; or SEQ ID NOs: 40-42, respectively, and wherein the VH, when paired with a light chain variable region (VL) comprising the amino acid sequence set forth in SEQ ID NO: 43 binds to MUC1; or

(16) an immunoglobulin light chain or a fragment thereof comprising a VL comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 1-3; or SEQ ID NOs: 22-24, respectively, and wherein the VL, when paired with a VH comprising the amino acid sequence set forth in SEQ ID NO: 49 binds to MUC1.

4. The nucleic acid of claim 3, wherein:

(i) the nucleic acid comprises a polynucleotide encoding a polypeptide comprising an immunoglobulin light chain or a fragment thereof comprising a VL comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 1-3; or SEQ ID NOs: 22-24, respectively;

(ii) the nucleic acid comprises a polynucleotide encoding a polypeptide comprising an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 7-9; or SEQ ID NOs: 28-30, respectively;

(iii) the nucleic acid comprises a polynucleotide encoding a polypeptide comprising an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 7, 63, 9; or SEQ ID NOs: 28, 65, 30, respectively;

(iv) the nucleic acid comprises a polynucleotide encoding a polypeptide comprising an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 7, 64, 9; or SEQ ID NOs: 28, 66, 30, respectively;

(v) the nucleic acid comprises a polynucleotide encoding a polypeptide comprising an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 4-6; or SEQ ID NOs: 25-27, respectively;

(vi) the nucleic acid comprises a polynucleotide encoding a polypeptide comprising an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 10-12; or SEQ ID NOs: 31-33, respectively;

(vii) the nucleic acid comprises a polynucleotide encoding a polypeptide comprising an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 13-15; or SEQ ID NOs: 34-36, respectively;

(viii) the nucleic acid comprises a polynucleotide encoding a polypeptide comprising an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 16-18; or SEQ ID NOs: 37-39, respectively; or

(ix) the nucleic acid comprises a polynucleotide encoding a polypeptide comprising an immunoglobulin heavy chain or a fragment thereof comprising a VH comprising CDRs 1, 2, and 3 comprising the amino acid sequences set forth in SEQ ID NOs: 19-21; or SEQ ID NOs: 40-42, respectively.

5. The nucleic acid of any one of claim 3 or 4, which has one or more features selected from the following:

(i) the VH when paired with a VL specifically binds to human, mouse, monkey, or dog MUC1, or the VL when paired with a VH specifically binds to human, mouse, monkey, or dog MUC1;

(ii) the immunoglobulin heavy chain or the fragment thereof is a human immunoglobulin heavy chain or a fragment thereof (e.g., a human IgG1 heavy chain or a fragment thereof; or a human IgG4 heavy chain or a fragment thereof), and the immunoglobulin light chain or the fragment thereof is a human immunoglobulin light chain or a fragment thereof;

(iii) the nucleic acid encodes a single-chain variable fragment (scFv), a one-armed antibody, a multi-specific antibody (e.g., a bispecific antibody), or a chimeric antigen receptor (CAR);

(iv) the nucleic acid is cDNA.

6. A vector comprising one or more of the nucleic acids of any one of claims 3-5; wherein optionally, the vector comprises two of the nucleic acids of any one of claims 3-5, wherein the vector encodes the VL region and the VH region that together bind to MUC1.

7. A cell comprising (i) the vector of claim 6, or (ii) one or more of the nucleic acids of any one of claims 3-5; wherein optionally, the cell is a CHO cell.

8. A method of producing an antibody or an antigen-binding fragment thereof, the method comprising

(a) culturing the cell of any one of claim 7 under conditions sufficient for the cell to produce the antibody or the antigen-binding fragment; and
(b) collecting the antibody or the antigen-binding fragment produced by the cell.

9. An antibody or antigen-binding fragment thereof that binds to MUC1 comprising a heavy chain variable region (VH) comprising an amino acid sequence that is at least 90% identical to a selected VH sequence, and a light chain variable region (VL) comprising an amino acid sequence that is at least 90% identical to a selected VL sequence, wherein the selected VH sequence and the selected VL sequence are one of the following:
(1) the selected VH sequence is SEQ ID NO: 45, and the selected VL sequence is SEQ ID NO: 43;
(2) the selected VH sequence is SEQ ID NO: 61, and the selected VL sequence is SEQ ID NO: 43;
(3) the selected VH sequence is SEQ ID NO: 62, and the selected VL sequence is SEQ ID NO: 43;
(4) the selected VH sequence is SEQ ID NO: 44, and the selected VL sequence is SEQ ID NO: 43;
(5) the selected VH sequence is SEQ ID NO: 46, and the selected VL sequence is SEQ ID NO: 43;
(6) the selected VH sequence is SEQ ID NO: 47, and the selected VL sequence is SEQ ID NO: 43;
(7) the selected VH sequence is SEQ ID NO: 48, and the selected VL sequence is SEQ ID NO: 43; and
(8) the selected VH sequence is SEQ ID NO: 49, and the selected VL sequence is SEQ ID NO: 43.

10. The antibody or antigen-binding fragment thereof of claim 9, wherein:
(1) the VH comprises the sequence of SEQ ID NO: 45 and the VL comprises the sequence of SEQ ID NO: 43;
(2) the VH comprises the sequence of SEQ ID NO: 61 and the VL comprises the sequence of SEQ ID NO: 43;
(3) the VH comprises the sequence of SEQ ID NO: 62 and the VL comprises the sequence of SEQ ID NO: 43;
(4) the VH comprises the sequence of SEQ ID NO: 44 and the VL comprises the sequence of SEQ ID NO: 43;
(5) the VH comprises the sequence of SEQ ID NO: 46 and the VL comprises the sequence of SEQ ID NO: 43;
(6) the VH comprises the sequence of SEQ ID NO: 47 and the VL comprises the sequence of SEQ ID NO: 43;
(7) the VH comprises the sequence of SEQ ID NO: 48 and the VL comprises the sequence of SEQ ID NO: 43; or

(8) the VH comprises the sequence of SEQ ID NO: 49 and the VL comprises the sequence of SEQ ID NO: 43.

11. An antibody or antigen-binding fragment thereof that binds to MUC1 comprising a heavy chain variable region (VH) comprising VH CDR1, VH CDR2, and VH CDR3 that are identical to VH CDR1, VH CDR2, and VH CDR3 of a selected VH sequence; and a light chain variable region (VL) comprising VL CDR1, VL CDR2, and VL CDR3 that are identical to VL CDR1, VL CDR2, and VL CDR3 of a selected VL sequence, wherein the selected VH sequence and the selected VL sequence are one of the following:

(1) the selected VH sequence is SEQ ID NO: 45, and the selected VL sequence is SEQ ID NO: 43;
(2) the selected VH sequence is SEQ ID NO: 61, and the selected VL sequence is SEQ ID NO: 43;
(3) the selected VH sequence is SEQ ID NO: 62, and the selected VL sequence is SEQ ID NO: 43;
(4) the selected VH sequence is SEQ ID NO: 44, and the selected VL sequence is SEQ ID NO: 43;
(5) the selected VH sequence is SEQ ID NO: 46, and the selected VL sequence is SEQ ID NO: 43;
(6) the selected VH sequence is SEQ ID NO: 47, and the selected VL sequence is SEQ ID NO: 43;
(7) the selected VH sequence is SEQ ID NO: 48, and the selected VL sequence is SEQ ID NO: 43; and
(8) the selected VH sequence is SEQ ID NO: 49, and the selected VL sequence is SEQ ID NO: 43.

12. The antibody or antigen-binding fragment thereof of any one of claims 1-2, and 9-11, which has one or more features selected from the following:

(i) the antibody or antigen-binding fragment thereof specifically binds to human, mouse, monkey, or dog MUC1;

(ii) the antibody or antigen-binding fragment thereof is a human antibody or antigen-binding fragment thereof, a single-chain variable fragment (scFv), a one-armed antibody, and/or a multi-specific antibody (e.g., a bispecific antibody);

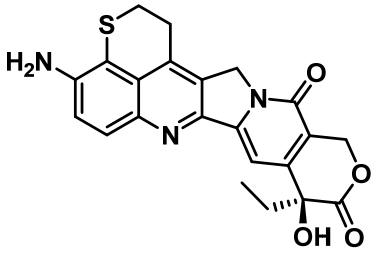
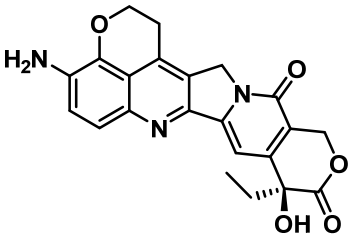
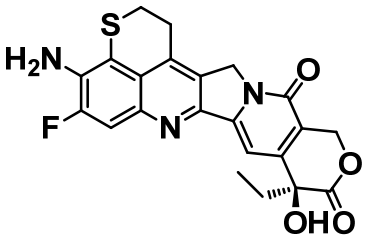
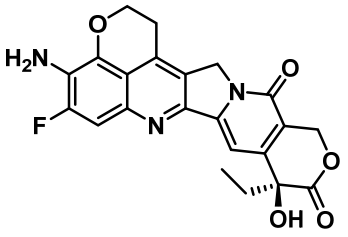
(iii) the antibody or antigen-binding fragment thereof is a human IgG1 antibody or antigen-binding fragment thereof or a human IgG4 antibody or antigen-binding fragment thereof.

13. An antibody or antigen-binding fragment thereof that cross-competes with the antibody or antigen-binding fragment thereof of any one of claims 1-2 and 9-12.

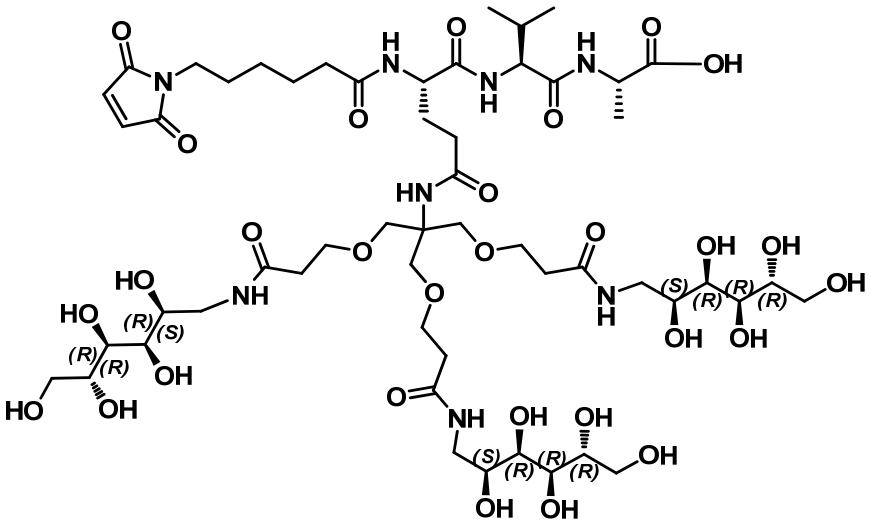
14. A chimeric antigen receptor (CAR) comprising the antibody or antigen-binding fragment thereof of any one of claims 1-2 and 9-12.

15. An antibody-drug conjugate comprising the antibody or antigen-binding fragment thereof of any one of claims 1-2 and 9-12 covalently bound to a therapeutic agent.

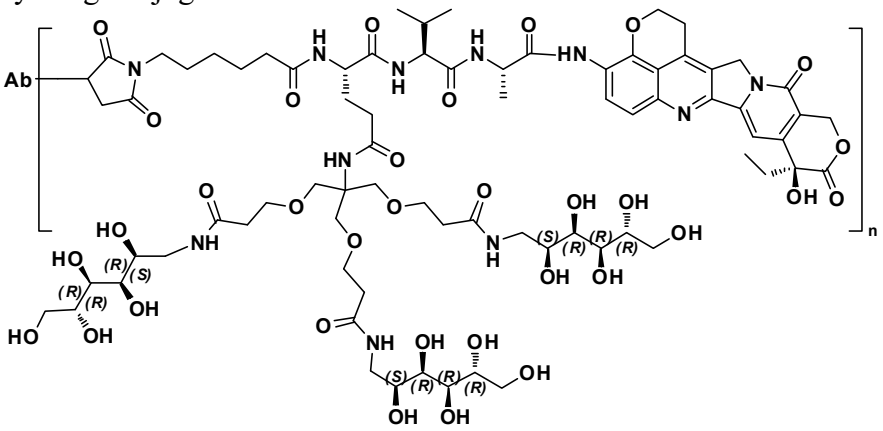
16. The antibody-drug conjugate of claim 15, which has one or more features selected from the following:
(i) the therapeutic agent is a cytotoxic or cytostatic agent;
(ii) the therapeutic agent is MMAE or MMAF;
(iii) wherein the therapeutic agent is selected from


(CPT-1),

(CPT-2),

(CPT-3), or

(CPT-4);

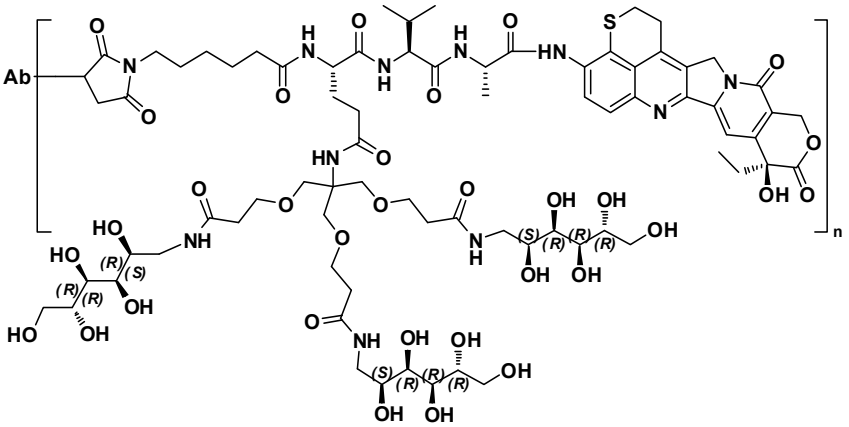
(iv) the therapeutic agent is linked to the antibody or antigen-binding fragment thereof via a linker;
(v) the therapeutic agent is linked to the antibody or antigen-binding fragment thereof via a linker, the linker has a structure of:


;

(vi) the antibody-drug conjugate has a structure of:



, or



wherein n = 1-8; wherein "Ab" represents the antibody or antigen-binding fragment thereof.

17. Use of a composition comprising the antibody or antigen-binding fragment thereof of any one of claims 1-2 and 9-12, the CAR of claim 14, or the antibody-drug conjugate of claim 15 or 16, in manufacture of a medicament, wherein the medicament is used for:

(a) treating a subject having cancer;

(b) decreasing the rate of tumor growth;

(c) killing a tumor cell;

(d) increasing immune response in a subject.

18. The use of claim 17, which has one or more features selected from the following:

(i) the subject has a solid tumor;

(ii) the cancer is oesophageal cancer, gastric cancer, breast cancer, ovarian cancer, bladder cancer, pancreatic cancer, lung cancer, colorectal cancer, stomach cancer, or Non-Hodgkin Lymphoma;

(iii) the subject is further treated with an effective amount of an anti-4-1BB antibody, an anti-OX40 antibody, an anti-PD-1 antibody, an anti-CTLA4 antibody, an anti-CD40 antibody, or an anti-PD-L1 antibody.

19. A pharmaceutical composition comprising the antibody or antigen-binding fragment thereof of any one of claims 1-2 and 9-12 or the antibody drug conjugate of claim 15 or 16, and a pharmaceutically acceptable carrier.