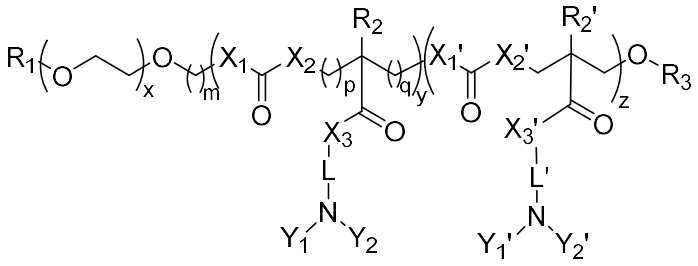
WHAT IS CLAIMED IS:

1. A polymer of the formula:



(I)

wherein:

R_1 is hydrogen, $alkyl_{(C\leq 8)}$, substituted $alkyl_{(C\leq 8)}$, or a thiol reactive group;

m is an integer from 1 to 8;

p and q are each independently 1, 2, or 3;

x is an integer from 10 to 200;

y is an integer from 20 to 200;

z is an integer from 0 to 200;

wherein the monomer of either y or z is randomly distributed in the polymer;

X_1, X_2, X_1', and X_2' are each independently O or NR_a, wherein:

R_a is $alkyl_{(C\leq 6)}$ or substituted $alkyl_{(C\leq 6)}$;

R_2 and R_2' are each independently hydrogen, $alkyl_{(C\leq 8)}$, or substituted $alkyl_{(C\leq 8)}$;

R_3 is hydrogen, $alkyl_{(C\leq 8)}$, or substituted $alkyl_{(C\leq 8)}$;

X_3 and X_3' are each independently O or NR_b, wherein:

R_b is hydrogen, $alkyl_{(C\leq 6)}$, or substituted $alkyl_{(C\leq 6)}$;

L and L′ are each independently a group of the formula:

$$-X_4-S(O)_n-X_5-$$

wherein:

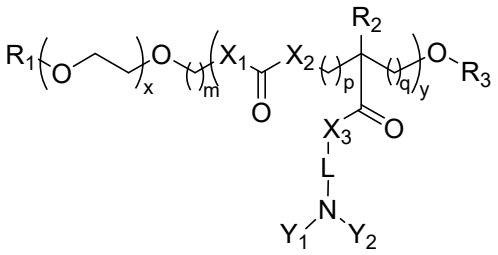
n is 0, 1, or 2; and

X_4 and X_5 are each independently $alkanediyl_{(C\leq 8)}$ or substituted $alkanediyl_{(C\leq 8)}$; and

Y_1, Y_2, Y_1', and Y_2' are each independently $alkyl_{(C\leq12)}$, substituted $alkyl_{(C\leq12)}$, $alkenyl_{(C\leq12)}$, or substituted $alkenyl_{(C\leq12)}$; or Y_1 and Y_2 or Y_1' and Y_2' are taken together and are $alkanediyl_{(C\leq12)}$, $alkenediyl_{(C\leq12)}$, or a substituted version of either group;

or a pharmaceutically acceptable salt thereof.

2. The polymer of claim 1 further defined as:



(II)

wherein:

R_1 is hydrogen, $alkyl_{(C\leq8)}$, substituted $alkyl_{(C\leq8)}$, or a thiol reactive group;

m is an integer from 1 to 8;

p and q are each independently 1, 2, or 3;

x is an integer from 10 to 200;

y is an integer from 20 to 200;

X_1 and X_2 are each O or NR_a, wherein:

R_a is hydrogen, $alkyl_{(C\leq6)}$, or substituted $alkyl_{(C\leq6)}$;

R_2 is hydrogen, $alkyl_{(C\leq8)}$, or substituted $alkyl_{(C\leq8)}$;

R_3 is hydrogen, $alkyl_{(C\leq8)}$, or substituted $alkyl_{(C\leq8)}$;

X_3 is O or NR_b, wherein:

R_b is hydrogen, $alkyl_{(C\leq6)}$, or substituted $alkyl_{(C\leq6)}$;

L is a group of the formula:

$$-X_4-S(O)_n-X_5-$$

wherein:

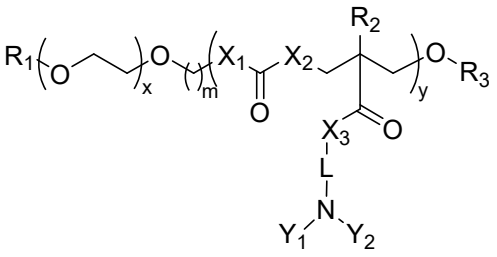
n is 0, 1, or 2; and

X_4 and X_5 are each independently alkanediyl$_{(C\leq 8)}$ or substituted alkanediyl$_{(C\leq 8)}$; and

Y_1 and Y_2 are each independently alkyl$_{(C\leq 12)}$, substituted alkyl$_{(C\leq 12)}$, alkenyl$_{(C\leq 12)}$, or substituted alkenyl$_{(C\leq 12)}$; or Y_1 and Y_2 are taken together and are alkanediyl$_{(C\leq 12)}$, alkenediyl$_{(C\leq 12)}$, or a substituted version of either group;

or a pharmaceutically acceptable salt thereof.

3. The polymer of either claim 1 or claim 2 further defined as:



(III)

wherein:

R_1 is hydrogen, alkyl$_{(C\leq 8)}$, substituted alkyl$_{(C\leq 8)}$, or a thiol reactive group;

m is an integer from 1 to 8;

x is an integer from 10 to 200;

y is an integer from 20 to 200;

X_1 and X_2 are each O or NR_a, wherein:

R_a is hydrogen, alkyl$_{(C\leq 6)}$, or substituted alkyl$_{(C\leq 6)}$;

R_2 is hydrogen, alkyl$_{(C\leq 8)}$, or substituted alkyl$_{(C\leq 8)}$;

R_3 is hydrogen, alkyl$_{(C\leq 8)}$, or substituted alkyl$_{(C\leq 8)}$;

X_3 is O or NR_b, wherein:

R_b is hydrogen, alkyl$_{(C\leq 6)}$, or substituted alkyl$_{(C\leq 6)}$;

L is a group of the formula:

$$-X_4-S(O)_n-X_5-$$

wherein:

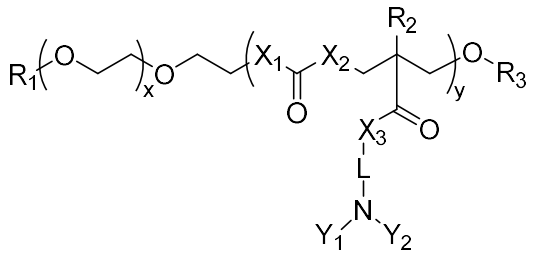
n is 0, 1, or 2; and

X_4 and X_5 are each independently alkanediyl$_{(C\leq 8)}$ or substituted alkanediyl$_{(C\leq 8)}$; and

Y_1 and Y_2 are each independently alkyl$_{(C\leq 12)}$, substituted alkyl$_{(C\leq 12)}$, alkenyl$_{(C\leq 12)}$, or substituted alkenyl$_{(C\leq 12)}$; or Y_1 and Y_2 are taken together and are alkanediyl$_{(C\leq 12)}$, alkenediyl$_{(C\leq 12)}$, or a substituted version of either group;

or a pharmaceutically acceptable salt thereof.

4. The polymer according to any one of claims 1-3 further defined as:



(IV)

wherein:

R_1 is hydrogen, alkyl$_{(C\leq 8)}$, substituted alkyl$_{(C\leq 8)}$, or a thiol reactive group;

x is an integer from 10 to 200;

y is an integer from 20 to 200;

X_1 and X_2 are each O or NR_a, wherein:

R_a is hydrogen, alkyl$_{(C\leq 6)}$, or substituted alkyl$_{(C\leq 6)}$;

R_2 is hydrogen, alkyl$_{(C\leq 8)}$, or substituted alkyl$_{(C\leq 8)}$;

R_3 is hydrogen, alkyl$_{(C\leq 8)}$, or substituted alkyl$_{(C\leq 8)}$;

X_3 is O or NR_b, wherein:

R_b is hydrogen, alkyl$_{(C\leq 6)}$, or substituted alkyl$_{(C\leq 6)}$;

L is a group of the formula:

$$-X_4-S(O)_n-X_5-$$

wherein:

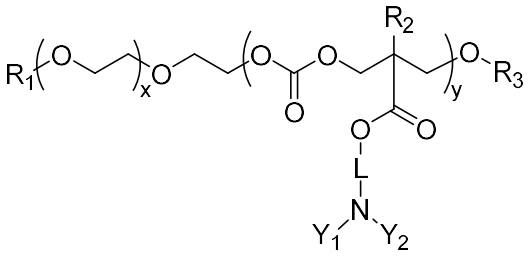
n is 0, 1, or 2; and

X_4 and X_5 are each independently alkanediyl$_{(C\leq 8)}$ or substituted alkanediyl$_{(C\leq 8)}$; and

Y_1 and Y_2 are each independently alkyl$_{(C\leq 12)}$, substituted alkyl$_{(C\leq 12)}$, alkenyl$_{(C\leq 12)}$, or substituted alkenyl$_{(C\leq 12)}$; or Y_1 and Y_2 are taken together and are alkanediyl$_{(C\leq 12)}$, alkenediyl$_{(C\leq 12)}$, or a substituted version of either group;

or a pharmaceutically acceptable salt thereof.

5. The polymer according to any one of claims 1-4 further defined as:



(V)

wherein:

R_1 is hydrogen, alkyl$_{(C\leq 8)}$, substituted alkyl$_{(C\leq 8)}$, or a thiol reactive group;

x is an integer from 10 to 200;

y is an integer from 20 to 200;

R_2 is hydrogen, alkyl$_{(C\leq 8)}$, or substituted alkyl$_{(C\leq 8)}$;

R_3 is hydrogen, alkyl$_{(C\leq 8)}$, or substituted alkyl$_{(C\leq 8)}$;

L is a group of the formula:

$$-X_4-S(O)_n-X_5-$$

wherein:

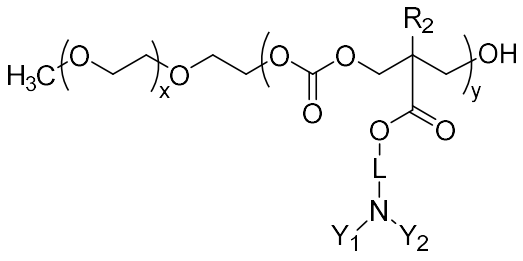
n is 0, 1, or 2; and

X_4 and X_5 are each independently alkanediyl$_{(C\leq 8)}$ or substituted alkanediyl$_{(C\leq 8)}$; and

Y_1 and Y_2 are each independently alkyl$_{(C\leq 12)}$, substituted alkyl$_{(C\leq 12)}$, alkenyl$_{(C\leq 12)}$, or substituted alkenyl$_{(C\leq 12)}$; or Y_1 and Y_2 are taken together and are alkanediyl$_{(C\leq 12)}$, alkenediyl$_{(C\leq 12)}$, or a substituted version of either group;

or a pharmaceutically acceptable salt thereof.

6. The polymer according to any one of claims 1-5 further defined as:



(VI)

wherein:

x is an integer from 10 to 200;

y is an integer from 20 to 200;

R_2 is hydrogen, $alkyl_{(C\leq 8)}$, or substituted $alkyl_{(C\leq 8)}$;

L is a group of the formula:

$$-X_4-S(O)_n-X_5-$$

wherein:

n is 0, 1, or 2; and

X_4 and X_5 are each independently $alkanediyl_{(C\leq 8)}$ or substituted $alkanediyl_{(C\leq 8)}$; and

Y_1 and Y_2 are each independently $alkyl_{(C\leq 12)}$, substituted $alkyl_{(C\leq 12)}$, $alkenyl_{(C\leq 12)}$, or substituted $alkenyl_{(C\leq 12)}$; or Y_1 and Y_2 are taken together and are $alkanediyl_{(C\leq 12)}$, $alkenediyl_{(C\leq 12)}$, or a substituted version of either group;

or a pharmaceutically acceptable salt thereof.

7. The polymer of either claim 1 or claim 2, wherein p is 1.

8. The polymer according to any one of claims 1, 2, or 7, wherein q is 1.

9. The polymer according to any one of claims 1-3, 7, and 8, wherein m is 1, 2, or 3.

10. The polymer of claim 9, wherein m is 2.

11. The polymer according to any one of claims 1-4 and 7-10, wherein X_1 is O.

12. The polymer according to any one of claims 1-4 and 7-11, wherein X_2 is O.

13. The polymer according to any one of claims 1-4 and 7-12, wherein X_3 is O.

14. The polymer according to any one of claims 1-5 and 7-13, wherein R_1 is $alkyl_{(C\leq 8)}$ or substituted $alkyl_{(C\leq 8)}$.

15. The polymer of claim 14, wherein R_1 is $alkyl_{(C\leq 8)}$.

16. The polymer of claim 15, wherein R_1 is methyl.

17. The polymer according to any one of claims 1-5 and 7-16, wherein R_3 is hydrogen.

18. The polymer according to any one of claims 1-17, wherein R_2 is $alkyl_{(C\leq 8)}$ or substituted $alkyl_{(C\leq 8)}$.

19. The polymer of claim 18, wherein R_2 is $alkyl_{(C\leq 8)}$.

20. The polymer of claim 19, wherein R_2 is methyl.

21. The polymer according to any one of claims 1-20, wherein X_4 of L is $alkanediyl_{(C\leq 6)}$ or substituted $alkanediyl_{(C\leq 6)}$.

22. The polymer of claim 21, wherein X_4 of L is $alkanediyl_{(C\leq 6)}$.

23. The polymer of claim 22, wherein X_4 of L is $-CH_2CH_2-$.

24. The polymer according to any one of claims 1-23, wherein X_5 of L is $alkanediyl_{(C\leq 6)}$ or substituted $alkanediyl_{(C\leq 6)}$.

25. The polymer of claim 24, wherein X_5 of L is $alkanediyl_{(C\leq 6)}$.

26. The polymer of claim 25, wherein X_5 of L is $-CH_2CH_2-$.

27. The polymer according to any one of claims 1-26, wherein n is 0.

28. The polymer according to any one of claims 1-27, wherein Y_1 is $alkyl_{(C\leq 12)}$ or substituted $alkyl_{(C\leq 12)}$.

29. The polymer of claim 28, wherein Y_1 is $alkyl_{(C2\text{-}12)}$ or substituted $alkyl_{(C2\text{-}12)}$.

30. The polymer of either claim 28 or claim 29, wherein Y_1 is $alkyl_{(C2\text{-}12)}$.

31. The polymer according to any one of claims 28-30, wherein Y_1 is methyl, ethyl, *n*-propyl, or *n*-butyl.

32. The polymer according to any one of claims 1-31, wherein Y_2 is $alkyl_{(C\leq 12)}$ or substituted $alkyl_{(C\leq 12)}$.

33. The polymer of claim 32, wherein Y_2 is $alkyl_{(C2\text{-}12)}$ or substituted $alkyl_{(C2\text{-}12)}$.

34. The polymer of either claim 32 or claim 33, wherein Y_2 is $alkyl_{(C2\text{-}12)}$.

35. The polymer according to any one of claims 32-34, wherein Y_2 is methyl, ethyl, *n*-propyl, or *n*-butyl.

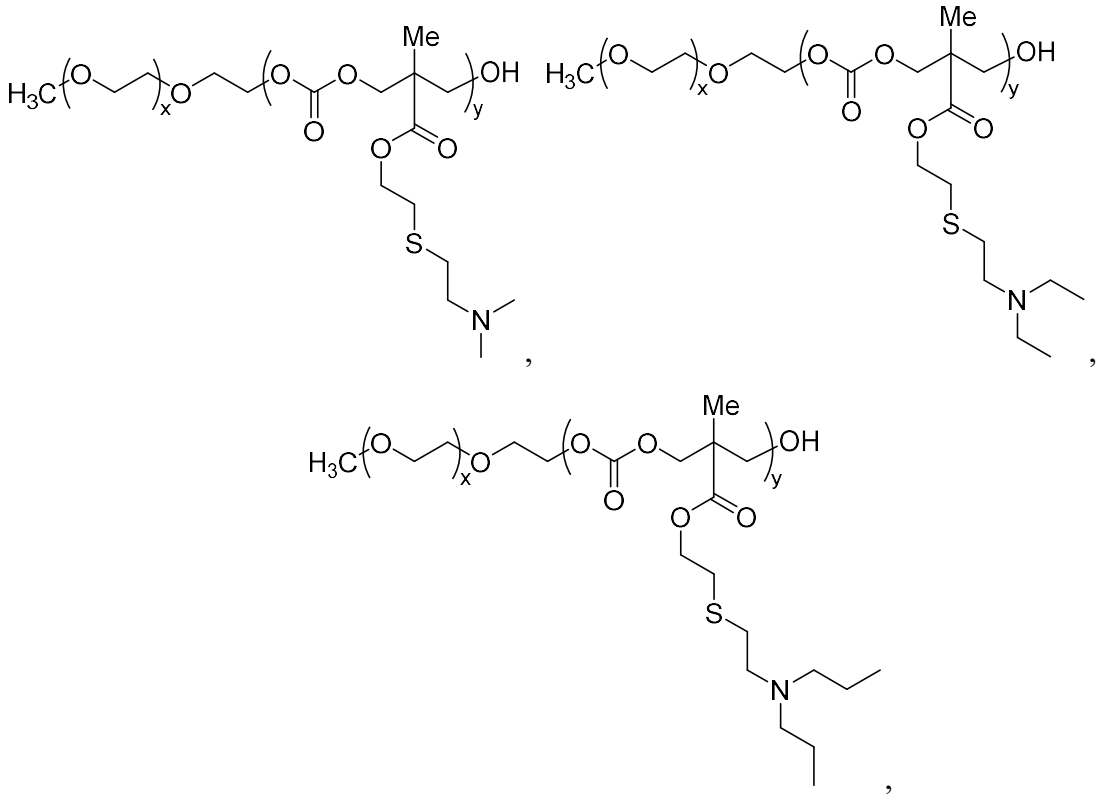
36. The polymer according to any one of claims 1-27, wherein Y_1 and Y_2 are taken together and are $alkanediyl_{(C\leq12)}$ or substituted $alkanediyl_{(C\leq12)}$.

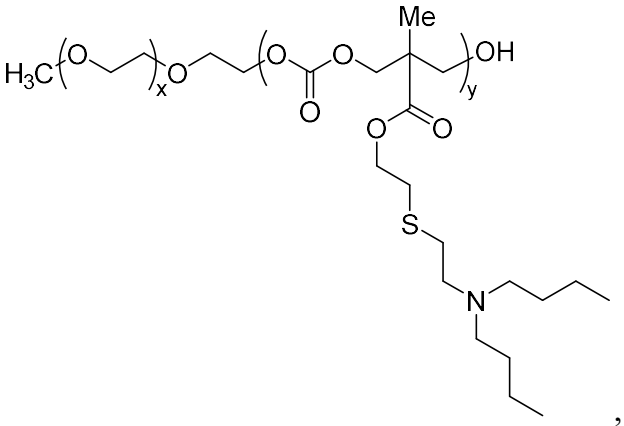
37. The polymer of claim 36, wherein Y_1 and Y_2 are taken together and are $alkanediyl_{(C\leq8)}$ or substituted $alkanediyl_{(C\leq8)}$.

38. The polymer of claim 37, wherein Y_1 and Y_2 are taken together and are $alkanediyl_{(C\leq8)}$.

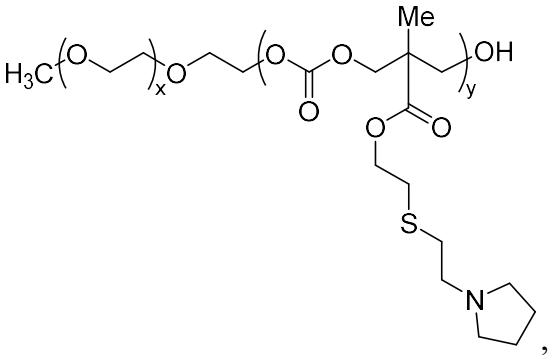
39. The polymer of claim 37, wherein Y_1 and Y_2 are taken together and are $-CH_2CH_2CH_2CH_2-$, $-CH_2CH_2CH_2CH_2CH_2-$, or $-CH_2CH_2CH_2CH_2CH_2CH_2-$.

40. The polymer according to any one of claims 1-39, wherein the polymer is further defined as:

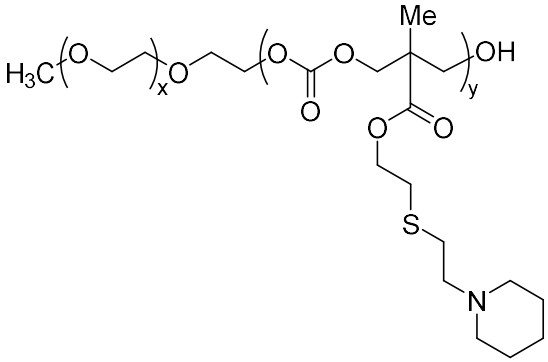


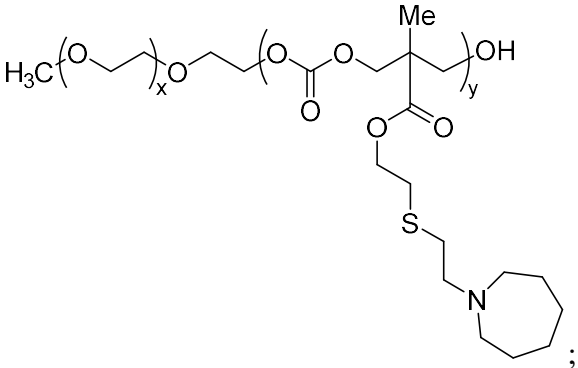


,



,





, or ;

or a pharmaceutically acceptable salt thereof.

41. The polymer according to any one of claims 1-40, wherein x is an integer from 40 to 160.

42. The polymer of claim 41, wherein x is an integer from 80 to 150.

43. The polymer according to any one of claims 1-42, wherein y is an integer from 40 to 180.

44. The polymer of claim 43, wherein y is an integer from 80 to 150.

45. A micelle comprising a plurality of polymers according to any one of claims 1-44.

46. A composition comprising:

(A) a polymer according to any one of claims 1-44; and

(B) a therapeutic agent;

wherein the polymer encapsulates the therapeutic agent.

47. The composition of claim 46, wherein the polymer forms a micelle.

48. The composition of either claim 46 or claim 47, wherein the micelle completely encapsulates the therapeutic agent.

49. The composition according to any one of claims 46-48, wherein the therapeutic agent is an agent which effects the immune system.

50. The composition of claim 49, wherein the therapeutic agent is a cytokine or an immune system modulator.

51. The composition of claim 50, wherein the cytokine is IL-1β, IL-2, IL-12, or IL-15.

52. The composition of claim 50, wherein the immune system modulator is cGAMP or a type 1 interferon.

53. The composition of claim 49, wherein the therapeutic agent is an antigen.

54. The composition of claim 53, wherein the antigen is an anti-cancer antigen.

55. The composition of claim 54, wherein the anti-cancer antigen is E7 peptide.

56. The composition according to any one of claims 46-55, wherein the composition is formulated as a pharmaceutical composition and further comprises an excipient.

57. The composition of claim 56, wherein the pharmaceutical composition is formulated for administration: orally, intraadiposally, intraarterially, intraarticularly, intracranially, intradermally, intralesionally, intramuscularly, intranasally, intraocularly, intrapericardially, intraperitoneally, intrapleurally, intraprostatically, intrarectally, intrathecally, intratracheally, intratumorally, intraumbilically, intravaginally, intravenously, intravesicularlly, intravitreally, liposomally, locally, mucosally, parenterally, rectally, subconjunctival, subcutaneously, sublingually, topically, transbuccally, transdermally, vaginally, in crèmes, in lipid compositions, via a catheter, via a lavage, via continuous infusion, via infusion, via inhalation, via injection, via local delivery, or via localized perfusion.

58. The composition of claim 57, wherein the pharmaceutical composition is formulated for administration via injection.

59. The composition of claim 57, wherein the pharmaceutical composition is formulated for intraarterial administration, intramuscular administration, intraperitoneal administration, intratumoral administration, or intravenous administration.

60. The composition according to any one of claims 56-59, wherein the excipient is a vehicle.

61. The composition of claim 60, wherein the vehicle is an aqueous solution suitable for injection.

62. Use of a composition according to any one of claims 46-61 in the manufacture of a medicament for the treatment of a disease or disorder in a patient, wherein the therapeutic agent is sufficient to treat the disease or disorder.

63. The use of claim 62, wherein the disease or disorder is cancer.

64. The use of either claim 62 or claim 63, wherein the therapeutic agent is capable of modulating the immune system to target cancer.

65. The use according to any one of claims 62-64, wherein the therapeutic agent generates an immune response to one or more cancer cells.