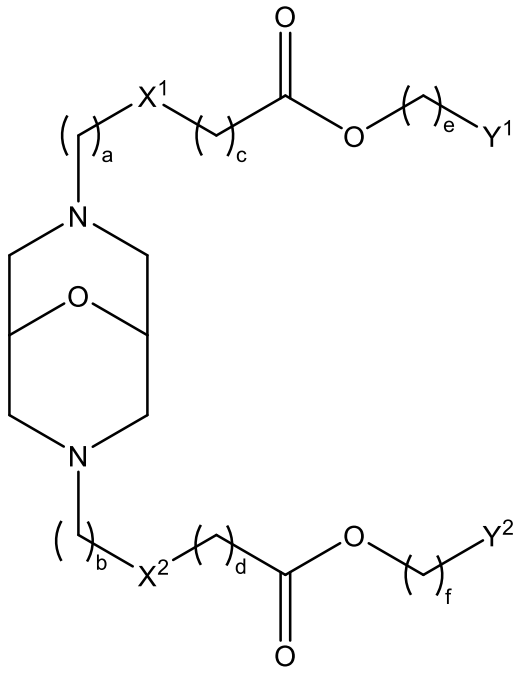
Claims

1. A compound of Formula (I):



(I),

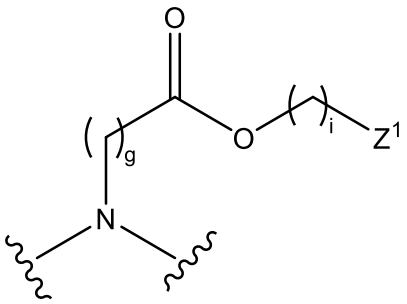
or a pharmaceutically acceptable salt thereof, wherein

a and b are each independently 3, 4 or 5;

c and d are each independently 1, 2 or 3;

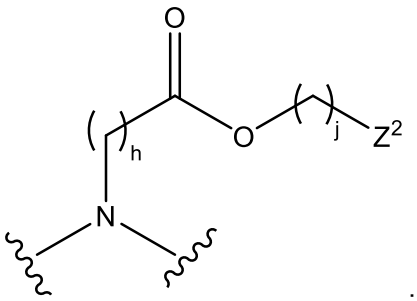
e and f are each independently 0, 1 or 2;

X^1 is methylene or



;

X^2 is methylene or

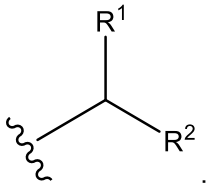


;

g and h are each independently 1, 2 or 3;

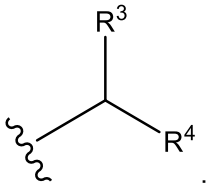
i and j are each independently 0, 1 or 2;

Y^1 and Y^2 are each independently straight-chain C_{7-10} alkyl, straight-chain C_{7-10} alkenyl, or



;

Z^1 and Z^2 are each independently straight-chain C_{7-10} alkyl, straight-chain C_{7-10} alkenyl, or



;

R^1 and R^2 are each independently straight-chain C_{7-10} alkyl; and

R^3 and R^4 are each independently straight-chain C_{7-10} alkyl.

2. The compound of claim 1, wherein X^1 and X^2 are both methylene.

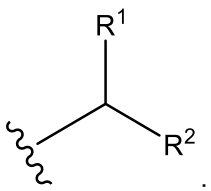
3. The compound of claim 1 or 2, wherein a and b are both 4; and c and d are both 2.

4. The compound of any one of claims 1 to 3, wherein e and f are both 0.

5. The compound of any one of claims 1 to 4, wherein

Y^1 is straight-chain C_{7-10} alkyl or straight-chain C_{7-10} alkenyl;

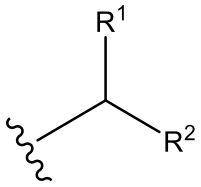
Y^2 is



; and

R^1 and R^2 are each independently straight-chain C_{7-10} alkyl.

6. The compound of any one of claims 1 to 4, wherein Y^1 and Y^2 are each independently

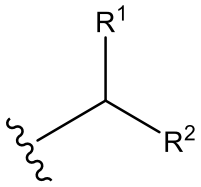


; and

R^1 and R^2 are each independently straight-chain C_{7-10} alkyl.

7. The compound of any one of claims 1 to 3, wherein e and f are each independently 1 or 2.

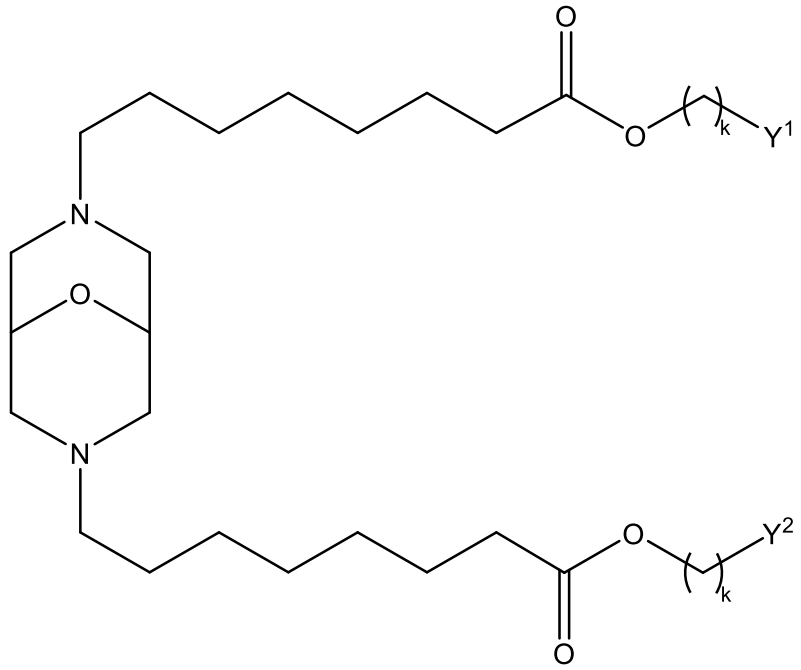
8. The compound of claim 7, wherein Y^1 and Y^2 are each independently



; and

R^1 and R^2 are each independently straight-chain C_{7-10} alkyl.

9. The compound of any one of claims 1 to 6 and 8, which is of Formula (II):

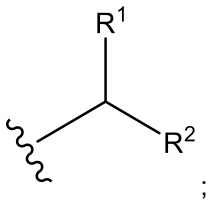


(II),

wherein

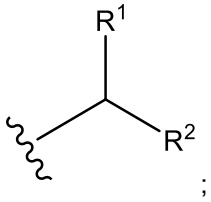
k is 0, 1 or 2;

Y^1 is straight-chain C_{7-10} alkyl, straight-chain C_{7-10} alkenyl, or



;

Y^2 is

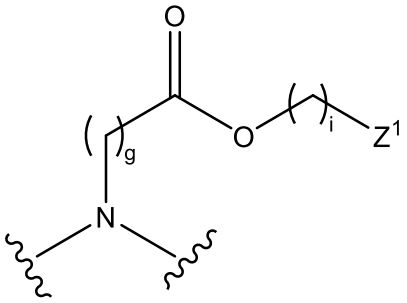


;

R^1 and R^2 are each independently straight-chain C_{7-10} alkyl.

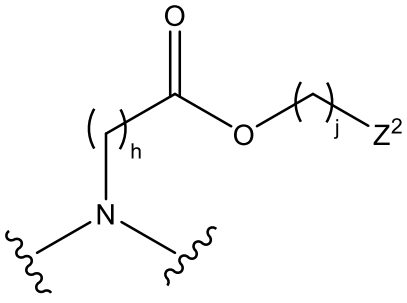
10. The compound of claim 1, wherein

X^1 is



; and

X^2 is



.

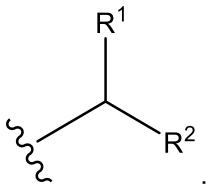
11. The compound of claim 10, wherein a and b are both 4; and c and d are both 2.

12. The compound of claim 10 or 11, wherein e and f are each independently 1 or 2.

13. The compound of any one of claims 10 to 12, wherein g and h are both 2.

14. The compound of any one of claims 10 to 13, wherein i and j are both 1.

15. The compound of any one of claims 10 to 14, wherein Y^1 and Y^2 are each independently



; and

R^1 and R^2 are each independently straight-chain C_{7-10} alkyl.

16. The compound of claim 1, which is selected from:

heptadecan-9-yl 8-(7-(8-(nonyloxy)-8-oxooctyl)-9-oxa-3,7-diazabicyclo[3.3.1]nonan-3-yl)octanoate;

heptadecan-9-yl (Z)-8-(7-(8-(non-2-en-1-yloxy)-8-oxooctyl)-9-oxa-3,7-diazabicyclo[3.3.1]nonan-3-yl)octanoate;

3-heptyldodecyl 8-(7-(8-((3-octylundecyl)oxy)-8-oxooctyl)-9-oxa-3,7-diazabicyclo[3.3.1]nonan-3-yl)octanoate;

di(heptadecan-9-yl) 8,8'-(9-oxa-3,7-diazabicyclo[3.3.1]nonane-3,7-diyl)dioctanoate; and

tetrakis(2-octyldecyl) 3,3',3'',3'''-(((9-oxa-3,7-diazabicyclo[3.3.1]nonane-3,7-diyl)bis(butane-4,1-diyl))bis(azanetriyl))tetrapropionate;

or a pharmaceutically acceptable salt thereof.

17. A lipid nanoparticle comprising the compound of any one of claims 1 to 16, or a pharmaceutically acceptable salt thereof.

18. The lipid nanoparticle of claim 17, further comprising at least one neutral lipid, at least one sterol and at least one polymer-conjugated lipid.

19. The lipid nanoparticle of claim 18, wherein the neutral lipid is selected from distearoyl phosphatidylcholine (DSPC), dioleoyl phosphatidylethanolamine (DOPE), dipalmitoyl phosphatidylcholine (DPPC), dimyristoyl phosphatidylcholine (DMPC) or combinations thereof.

20. The lipid nanoparticle of claim 18 or 19, wherein the sterol is cholesterol.

21. The lipid nanoparticle of any one of claims 18, 19 and 20, wherein the polymer-conjugated lipid is selected from DMPE-PEG2000, DPPE-PEG2000, DMG-PEG2000, DPG-PEG2000, PEG2000-c-DOMG, PEG-C-DOPG or combinations thereof.

22. The lipid nanoparticle of any one of claims 17 to 21, wherein the lipid nanoparticle further comprises distearoyl phosphatidylcholine (DSPC), cholesterol, and DMPE-PEG2000.

23. The lipid nanoparticle of any one of claims 17 to 22, further comprising a therapeutic agent.

24. The lipid nanoparticle of claim 23, wherein the therapeutic agent is a nucleic acid segment.

25. The lipid nanoparticle of claim 24, wherein the nucleic acid segment is an RNA.

26. The lipid nanoparticle of claim 25, wherein the RNA is a modified mRNA.

27. A pharmaceutical composition comprising a plurality of the lipid nanoparticles of any one of claims 23 to 26.

28. The pharmaceutical composition of claim 27 for use in the treatment of a disease or disorder.