CLAIMS

1. A nucleic acid vaccine, comprising:

one or more RNA polynucleotides having an open reading frame encoding an antigenic polypeptide that is derived from an infectious agent, wherein the RNA polynucleotide includes a chemical modification and a pharmaceutically acceptable carrier or excipient, formulated within a lipid nanoparticle having a molar ratio of about 20-60% ionizable cationic lipid: about 5-25% non-cationic lipid: about 25-55% sterol; and about 0.5-15% PEG-modified lipid.

2. The vaccine of claim 1, wherein the cationic lipid nanoparticle comprises a molar ratio of about 50% cationic lipid, about 1.5% PEG-modified lipid, about 38.5% cholesterol and about 10% non-cationic lipid.

3. The vaccine of claim 1, wherein the cationic lipid nanoparticle comprises a molar ratio of about 55% cationic lipid, about 2.5% PEG lipid, about 32.5% cholesterol and about 10% non-cationic lipid.

4. The vaccine of claim 1, wherein the cationic lipid is an ionizable cationic lipid and the non-cationic lipid is a neutral lipid, and the sterol is a cholesterol.

5. The vaccine of any one of claims 1-4, wherein the open reading frame is codon-optimized.

6. The vaccine of any one of claims 1-5, wherein the antigenic polypeptide is derived from an infectious agent.

7. The vaccine of claim 6, wherein the infectious agent is selected from a member of the group consisting of strains of viruses and strains of bacteria.

8. The vaccine of any one of claims 1-7, wherein the one or more RNA polynucleotides encode a further antigenic polypeptide.

9. The vaccine of any one of claims 1-7, wherein the antigenic polypeptide is selected from those proteins listed in Tables 6-14, Tables 29-30, or antigenic fragments thereof.

10. The vaccine of any one of claims 1-7, wherein the open reading frame of the one or more RNA polynucleotides encodes an antigenic polypeptide selected from Tables 6-11, Tables 22-23, or antigenic fragments thereof.

11. The vaccine of any one of claims 1-7, wherein each of the open reading frame of the one or more RNA polynucleotides is selected from any of the RNA sequences from Table 28, or antigenic fragments thereof.

12. The vaccine of any one of claims 1-7, wherein the infectious agent is a strain of Influenza A or Influenza B or combinations thereof.

13. The vaccine of claim 12, wherein the strain of Influenza A or Influenza B is associated with birds, pigs, horses, dogs, humans or non-human primates.

14. The vaccine of any one of claims 1-12, wherein the antigenic polypeptide encodes a hemagglutinin protein or fragment thereof.

15. The vaccine of claim 14, wherein the hemagglutinin protein is H1, H2, H3, H4, H5, H6, H7, H8, H9, H10, H11, H12, H13, H14, H15, H16, H17, H18, or a fragment thereof.

16. The vaccine of claim 14 or 15, wherein the hemagglutinin protein does not comprise a head domain (HA1).

17. The vaccine of claim 14 or 15, wherein the hemagglutinin protein comprises a portion of the head domain (HA1).

18. The vaccine of any one of claim 14-17, wherein the hemagglutinin protein does not comprise a cytoplasmic domain.

19. The vaccine of any one of claim 14-17, wherein the hemagglutinin protein comprises a portion of the cytoplasmic domain.

20. The vaccine of any one of claims 14-17, wherein the truncated hemagglutinin protein.

21. The vaccine of any one of claims 14-17, wherein the truncated hemagglutinin protein comprises a portion of the transmembrane domain.

22. The vaccine of any one of claims 14-21, wherein the amino acid sequence of the hemagglutinin protein or fragment thereof comprises at least 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97% 98%, or 99% identify with any of the amino acid sequences provided in Table 14-16.

23. The vaccine of claim 14, wherein the virus is selected from the group consisting of H1N1, H3N2, H7N9, and H10N8.

24. The vaccine of claim 14, wherein the antigenic polypeptide is selected from those proteins listed in Tables 6-12, or fragments thereof.

25. The vaccine of any one of claims 1-24, wherein the nucleic acid vaccine is multivalent.

26. The vaccine of claim 259, wherein the open reading frame of the one or more RNA polynucleotides encode at least 2, 3, 4, 5, 6, 7, 8, 9 or 10 antigenic polypeptides.

27. The vaccine of claim 25, wherein the open reading frame of the one or more RNA polynucleotides encode at least 10, 15, 20 or 50 antigenic polypeptides.

28. The vaccine of claim 25, wherein the open reading frame of the one or more RNA polynucleotides encode 2-10, 10-15, 15-20, 20-50, 50-100 or 100-200 antigenic polypeptides.

29. The vaccine of any one of claims 1-28, wherein the chemical modification is selected from any of those listed in Tables 22 and 23.

30. The vaccine of claim 29, wherein the chemical modification is selected from the group consisting of pseudouridine, N1-methylpseudouridine, 2-thiouridine, 4’-thiouridine, 5-

methylcytosine, 2-thio-1-methyl-1-deaza-pseudouridine, 2-thio-1-methyl-pseudouridine, 2-thio-5-aza-uridine , 2-thio-dihydropseudouridine, 2-thio-dihydrouridine, 2-thio-pseudouridine, 4-methoxy-2-thio-pseudouridine, 4-methoxy-pseudouridine, 4-thio-1-methyl-pseudouridine, 4-thio-pseudouridine, 5-aza-uridine, dihydropseudouridine, 5-methoxyuridine, and 2'-O-methyl uridine.

31. The vaccine of claim 30, further comprising a second chemical modification wherein said second chemical modification is selected from any of those listed in Tables 22 and 23.

32. The vaccine of claim 31, wherein the combination of first and second chemical modification is selected from those listed in Table 25.

33. A vaccine of any one of claims 1-32 for use in inducing an antigen specific immune response in a subject.

34. Use of a vaccine of any one of claims 1-32 in the manufacture of a medicament for use in inducing an antigen specific immune response in a subject.