We claim:

1. A recombinant respiratory syncytial virus (RSV) antigen comprising an RSV F protein polypeptide without a transmembrane domain, comprising an F_2 domain and an F_1 domain of an RSV F protein polypeptide, wherein the F protein polypeptide comprises at least one modification that increases glycosylation, which at least one modification that increases glycosylation comprises a substitution of one or more amino acids comprising and/or adjacent to the amino acid corresponding position 500 of SEQ ID NO:2.

2. The recombinant RSV antigen of claim 1, wherein the F protein polypeptide comprises at least one modification selected from:

(i) an addition of an amino acid sequence comprising a heterologous trimerization domain;

(ii) a deletion of at least one furin protease cleavage site;

(iii) a deletion of at least one non-furin protease cleavage site;

(iv) a deletion of one or more amino acids of the pep27 domain; and

(v) at least one substitution or addition of a hydrophilic amino acid in a hydrophobic domain of the F protein extracellular domain.

3. The recombinant RSV antigen of any one of claims 1 or 2, wherein amino acids corresponding to positions 500-502 of SEQ ID NO:2 are selected from: NGS; NKS; NGT; NKT.

4. The recombinant RSV antigen of any one of claims 1-3, wherein the modification that increases glycosylation comprises a substitution of glutamine at the amino acid corresponding to position 500 of SEQ ID NO:2.

5. The recombinant RSV antigen of any one of claims 1-4, wherein the soluble F protein polypeptide comprises an intact fusion peptide between the F2 domain and the F1 domain.

6. The recombinant RSV antigen of any one of claims 1-5, wherein the at least one modification comprises the addition of an amino acid sequence comprising a heterologous trimerization domain.

7. The recombinant RSV antigen of claim 6, wherein the heterologous trimerization domain is positioned C-terminal to the F_1 domain.

8. The recombinant RSV antigen of any one of claims 1-7, comprising an F2 domain and an F1 domain with no intervening furin cleavage site.

9. The recombinant RSV antigen of any one of claims 1-8, wherein the F_2 domain comprises at least a portion of an RSV F protein polypeptide corresponding to amino acids 26-105 of the reference F protein precursor polypeptide (F_0) of SEQ ID NO:2.

10. The recombinant RSV antigen of any one of claims 1-9, wherein the F_1 domain comprises at least a portion of an RSV F protein polypeptide corresponding to amino acids 137-516 of the reference F protein precursor polypeptide (F_0) of SEQ ID NO:2.

11. The recombinant RSV antigen of any one of claims 1-10, wherein the RSV antigen is selected from the group of:

a) a polypeptide comprising SEQ ID NO:22;

b) a polypeptide encoded by SEQ ID NO:21 or by a polynucleotide sequence that hybridizes under stringent conditions over substantially its entire length to SEQ ID NO:21;

c) a polypeptide with at least 95% sequence identity to SEQ ID NO:22.

12. The recombinant RSV antigen of any one of claims 1-11, wherein the RSV antigen comprises at least one amino acid addition, deletion or substitution that eliminates a furin cleavage site present in a naturally occurring F protein precursor (F_0).

13. The recombinant RSV antigen of claim 12, wherein the RSV antigen comprises an amino acid addition, deletion or substitution that eliminates a furin cleavage site at a position corresponding to amino acids 105-109, a position corresponding to amino acids 133-136, or at both positions corresponding to amino acids 105-109 and 133-136 of the reference F protein precursor (F_0) of SEQ ID NO:2.

14. The recombinant RSV antigen of any one of claims 1-13, wherein the RSV antigen comprises a multimer of polypeptides.

15. The recombinant RSV antigen of any one of claims 1-14, wherein the RSV antigen comprises a trimer of polypeptides.

16. An immunogenic composition comprising the recombinant RSV antigen of any one of claims 0-15, and a pharmaceutically acceptable carrier or excipient.

17. The immunogenic composition of claim 16, further comprising an adjuvant.

18. A recombinant nucleic acid comprising a polynucleotide sequence that encodes the recombinant RSV antigen of any one of claims 1-17.

19. The recombinant nucleic acid of claim 18, wherein the nucleic acid comprises a polynucleotide sequence selected from:

a) a polynucleotide sequence comprising SEQ ID NO:21;

b) a polynucleotide sequence that encodes SEQ ID NO:22;

c) a polynucleotide sequence that hybridizes under stringent conditions over substantially its entire length to SEQ ID NO:21;

d) a polynucleotide sequence with at least 95% sequence identity to SEQ ID NO:21, which polynucleotide sequence does not correspond to a naturally occurring RSV strain.

20. The use of the RSV antigen of any one of claims 1-15 or the nucleic acid of claim 19 in the preparation of a medicament for treating an RSV infection.

21. The use of claim 20, wherein the medicament is administered for the purpose of prophylactically treating an RSV infection.

22. The recombinant RSV antigen of any one of claims 1-15 or the immunogenic composition of any one of claims 16 or 17 for use in medicine.

23. The recombinant RSV antigen of any one of claims 1-15 or the immunogenic composition of any one of claims 16 or 17 for the prevention or treatment of RSV-associated diseases.

24. A method for producing a recombinant RSV antigen with an altered glycosylation pattern, the method comprising:

(i) expressing a nucleic acid of claim in a host cell; and

(ii) isolating the recombinant RSV antigen expressed thereby.

25. A method for increasing expression of an RSV fusion protein polypeptide, the method comprising:

expressing in a host cell a nucleic acid encoding an RSV fusion protein polypeptide comprising at least one mutation that produces an amino acid addition, deletion or substitution, which amino acid addition, deletion or substitution alters a glycosylation site of the encoded RSV fusion protein polypeptide as compared to a a naturally occurring RSV fusion protein, whereby altering the glycosylation site increases expression of the RSV fusion protein polypeptide as compared to an RSV fusion protein without the amino acid addition, deletion or substitution.

26. The method of claim 25, wherein the nucleic acid encoding the RSV fusion protein polypeptide further comprises an additional mutation that produces an amino acid addition, deletion or substitution that eliminates a peptidase cleavage site within the encoded RSV fusion protein polypeptide.

CLAIMS

1. A recombinant respiratory syncytial virus (RSV) antigen comprising an RSV F protein polypeptide without a transmembrane domain, comprising an F_2 domain and an F_1 domain of an RSV F protein polypeptide, wherein the F protein polypeptide comprises at least one modification that increases glycosylation, which at least one modification that increases glycosylation comprises a substitution wherein amino acids corresponding to positions 500-502 of SEQ ID NO:2 are selected from: NGS; NGT.

2. The recombinant RSV antigen of claim 1, wherein the F protein polypeptide comprises at least one modification selected from:

(i) an addition of an amino acid sequence comprising a heterologous trimerization domain;

(ii) an amino acid addition, deletion or substitution that eliminates a furin cleavage site at a position corresponding to amino acids 105-109, a position corresponding to amino acids 133-136, or at both positions corresponding to amino acids 105-109 and 133-136 of the reference F protein precursor (F_0) of SEQ ID NO:2;

(iii) a deletion of one or more amino acids of the pep27 domain; and

(iv) substitution of lysine for the leucine present at position 512 or addition of a lysine following the amino acid corresponding to residue 105 of reference SEQ ID NO:2.

3. The recombinant RSV antigen of any one of claims 1 - 2, wherein the soluble F protein polypeptide comprises the intact fusion peptide between the F2 domain and the F1 domain.

4. The recombinant RSV antigen of claim 2 or claim 3, wherein the at least one modification comprises the addition of an amino acid sequence comprising a heterologous trimerization domain.

5. The recombinant RSV antigen of claim 4, wherein the heterologous trimerization domain is positioned C-terminal to the F_1 domain.

6. The recombinant RSV antigen of any one of claims 2 - 5, comprising an F2 domain and an F1 domain with no intervening furin cleavage site.

7. The recombinant RSV antigen of any one of claims 1 - 6, wherein the F_2 domain comprises at least a portion of an RSV F protein polypeptide corresponding to amino acids 26-105 of the reference F protein precursor polypeptide (F_0) of SEQ ID NO:2.

8. The recombinant RSV antigen of any one of claims 1 - 7, wherein the F_1 domain comprises at least a portion of an RSV F protein polypeptide corresponding to amino acids 137-516 of the reference F protein precursor polypeptide (F_0) of SEQ ID NO:2.

9. The recombinant RSV antigen of any one of claims 1 - 8, wherein the RSV antigen is selected from the group of:

a) a polypeptide comprising SEQ ID NO:22;

b) a polypeptide encoded by SEQ ID NO:21;

c) a polypeptide with at least 95% sequence identity to SEQ ID NO:22.

10. The recombinant RSV antigen of any one of claims 1 – 9, wherein the RSV antigen comprises a multimer of polypeptides.

11. The recombinant RSV antigen of any one of claims 1 - 10, wherein the RSV antigen comprises a trimer of polypeptides.

12. An immunogenic composition comprising the recombinant RSV antigen of any one of claims 1 -11, and a pharmaceutically acceptable carrier or excipient.

13. The immunogenic composition of claim 12, further comprising an adjuvant.

14. A recombinant nucleic acid comprising a polynucleotide sequence that encodes the recombinant RSV antigen of any one of claims 1 - 11.

15. The recombinant nucleic acid of claim 14, wherein the nucleic acid comprises a polynucleotide sequence selected from:

a) a polynucleotide sequence comprising SEQ ID NO:21;

b) a polynucleotide sequence that encodes SEQ ID NO:22;

c) a polynucleotide sequence with at least 95% sequence identity to SEQ ID NO:21, which polynucleotide sequence does not correspond to a naturally occurring RSV strain.

16. The use of the RSV antigen of any one of claims 1 - 11 or the nucleic acid of claim 15 in the preparation of a medicament for treating an RSV infection.

17. The use of claim 16, wherein the medicament is administered for the purpose of prophylactically treating an RSV infection.

18. The recombinant RSV antigen of any one of claims 1 - 11 or the immunogenic composition of any one of claims 12 or 13 for use as a medicament.

19. The recombinant RSV antigen of any one of claims 1 - 11 or the immunogenic composition of any one of claims 12 or 13 for the prevention or treatment of an RSV infection.