[0068] Also disclosed herein is a fusion polynucleotide comprising a nucleotide sequence encoding: (i) a fragment antigen that comprises an epitope of a target protein antigen; and (ii) a complement C3d-binding polypeptide from an immunoglobulin-binding protein (Sbi) of Staphylococcus aureus. In one aspect, the present disclosure refers to a fusion polynucleotide comprising a nucleotide sequence encoding: (i) a fragment antigen, an antigen variant, or a fragment antigen variant, that comprises an epitope of a target protein antigen, wherein the target protein antigen is or comprises: (a) an infectious antigen chosen from a viral antigen or a fungal antigen or combinations thereof; or (b) a cancer antigen; and (ii) a complement C3d-binding polypeptide from an immunoglobulin-binding protein (Sbi) of *Staphylococcus aureus*, wherein the fusion polynucleotide is RNA. In another aspect, the present disclosure refers to a fusion polynucleotide comprising a nucleotide sequence encoding: (i) a fragment antigen, an antigen variant, or a fragment antigen variant, that comprises an epitope of a target protein antigen, wherein the target protein antigen is or comprises: (a) an infectious antigen chosen from a viral antigen or a fungal antigen or combinations thereof; or (b) a cancer antigen; and (ii) a complement C3d-binding polypeptide from an immunoglobulin-binding protein (Sbi) of *Staphylococcus aureus*, wherein the polynucleotide has at least 80% identity to the nucleotide sequence of any one of SEQ ID NOs: 47, 49, 50, 51, 52, 53, or 54, wherein the fusion polynucleotide is RNA.

[0069] Disclosed herein is a polynucleotide comprising a nucleotide sequence encoding: (i) an antigen variant or a fragment antigen variant that comprises an epitope of a target protein antigen; and (ii) a complement C3d-binding polypeptide from an immunoglobulin-binding protein (Sbi) of Staphylococcus aureus.

[0070] In some examples, a fusion polynucleotide is or comprises RNA. In some examples, a polynucleotide is or comprises messenger RNA.

[0071] In some examples, a fusion polynucleotide is or comprises DNA.

[0072] In some examples, a complement C3d-binding polypeptide encoded by the polynucleotide is or comprises one or both of domain III and domain IV of the Sbi of Staphylococcus aureus, or a functional fragment or a variant thereof. In some examples, a complement C3d-binding polypeptide encoded by the polynucleotide is or comprises domain III of the Sbi of Staphylococcus aureus, or a functional fragment or a variant thereof. In some examples, a complement C3d-binding polypeptide encoded

[0090] In some examples, a fusion polynucleotide has at least 80%, 85%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or 100% identity to the nucleotide sequence of SEQ ID NO: 52.

[0091] In some examples, a fusion polynucleotide has at least 80%, 85%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or 100% identity to the nucleotide sequence of SEQ ID NO: 53.

[0092] In some examples, a fusion polynucleotide has at least 80%, 85%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98%, 99% or 100% identity to the nucleotide sequence of SEQ ID NO: 54.

[0093] Disclosed herein is an expression vector comprising any one of the fusion polynucleotides disclosed herein.

[0094] In some examples, an expression vector comprises a viral vector. In some examples, a viral vector comprises a retrovirus vector, an adenovirus vector, an adeno-associated virus vector or a lentivirus vector or an RNA vector.

[0095] Also disclosed herein is a composition for delivering any one of the fusion polypeptides disclosed herein.

[0096] Disclosed herein is a composition for delivering any one of the fusion polynucleotides disclosed herein.

[0097] This disclosure provides a pharmaceutical composition that delivers a fusion polypeptide disclosed herein, a fusion polynucleotide disclosed herein, or an expression vector comprising a fusion polynucleotide disclosed herein. In one aspect, the present disclosure refers to a pharmaceutical composition comprising the fusion polynucleotide of claim 1, wherein the complement C3d-binding polypeptide is or comprises domain III and domain IV of the Sbi of *Staphylococcus aureus*, or a functional fragment or a variant thereof.

[0098] In some examples, a pharmaceutical composition further comprises a pharmaceutically acceptable excipient, a diluent, or a combination thereof.

[0099] Disclosed herein is a method of making comprising: recombinantly joining a first nucleotide sequence that encodes a fragment antigen comprising an epitope of a target protein antigen, and a second nucleotide sequence that encodes a complement C3d-binding polypeptide from a immunoglobulin-binding protein (Sbi) of Staphylococcus aureus to form a polynucleotide comprising the first nucleotide sequence and the second nucleotide sequence.

CLAIMS

What is claimed is:

1. A fusion polynucleotide comprising a nucleotide sequence encoding:

(i) a fragment antigen, an antigen variant, or a fragment antigen variant, that comprises an epitope of a target protein antigen, wherein the target protein antigen is or comprises:

(a) an infectious antigen chosen from a viral antigen or a fungal antigen or combinations thereof, or

(b) a cancer antigen, and

(ii) a complement C3d-binding polypeptide from an immunoglobulin-binding protein (Sbi) of *Staphylococcus aureus*,

wherein the fusion polynucleotide is RNA.

2. The fusion polynucleotide of claim 1, wherein the complement C3d-binding polypeptide is or comprises domain III and domain IV of the Sbi of *Staphylococcus aureus*, or a functional fragment or a variant thereof.

3. The fusion polynucleotide of claim 1, wherein the viral antigen is or comprises an influenza antigen or a coronavirus polypeptide.

4. The fusion polynucleotide of claim 3, wherein the coronavirus polypeptide is or comprises a SARS-CoV 2 protein chosen from: a Spike protein (SARS-CoV-2 S) or fragment thereof; an Envelope protein (SARS-CoV-2 E) or fragment thereof; a Membrane protein (SARS-CoV-2 M) or fragment thereof; a nucleocapsid protein (SARS-CoV-2 N) or fragment thereof; an accessory factor polypeptide or fragment thereof; or any combination thereof.

5. The fusion polynucleotide of claim 1, wherein (i) and (ii) are contiguous.

6. The fusion polynucleotide of claim 1, wherein the polynucleotide further comprises a nucleotide sequence encoding a secretion peptide.

7. A fusion polynucleotide comprising a nucleotide sequence encoding:

(i) a fragment antigen, an antigen variant, or a fragment antigen variant, that comprises an epitope of a target protein antigen, wherein the target protein antigen is or comprises:

(a) an infectious antigen chosen from a viral antigen or a fungal antigen or combinations thereof; or

(b) a cancer antigen; and

(ii) a complement C3d-binding polypeptide from an immunoglobulin-binding protein (Sbi) of *Staphylococcus aureus,*

wherein the polynucleotide has at least 80% identity to the nucleotide sequence of any one of SEQ ID NOs: 47, 49, 50, 51, 52, 53, or 54, wherein the fusion polynucleotide is RNA.

8. An expression vector comprising the fusion polynucleotide of claim 1.

9. The fusion polynucleotide of claim 1, wherein the polynucleotide encodes an antigen variant or fragment antigen variant which comprises at least one modified amino acid compared to the target protein antigen.

10. The fusion polynucleotide of claim 1, wherein the polynucleotide encodes a fragment antigen which is characterized in that when expressed in vivo, it binds to a Major Histocompatibility Complex (MHC) molecule.

11. The fusion polynucleotide of claim 10, wherein the MHC molecule is or comprises a MHC I molecule.

12. The fusion polynucleotide of claim 1, wherein the fragment antigen is characterized in that when expressed in vivo, it folds into a three-dimensional conformation that is similar to the three-dimensional conformation of the fragment antigen as it is in its native position in the target protein antigen.

13. The fusion polynucleotide of claim 1, wherein the fragment antigen encoded by the polynucleotide has an amino acid sequence length of:

(i) at least 5%compared to the amino acid sequence length of the target protein antigen;
(ii) no more than 50% of the amino acid sequence length of the target protein antigen;
(iii) 10-300 amino acid residues; or
(iv) any combination thereof.

14. The fusion polynucleotide of claim 1, wherein (i) is positioned N-terminus of (ii).

15. A pharmaceutical composition comprising the fusion polynucleotide of claim 1, wherein the complement C3d-binding polypeptide is or comprises domain III and domain IV of the Sbi of *Staphylococcus aureus*, or a functional fragment or a variant thereof.

16. A cell comprising the fusion polynucleotide of claim 1.

17. The fusion polynucleotide of claim 4, wherein the SARS-CoV-2 protein comprises a RBD domain.

18. The fusion polynucleotide of claim 17, wherein the SARS-CoV-2 protein encoded by the fusion polynucleotide has at least 80% identity to the sequence of any one of SEQ ID NOs: 3, 4, 5, 6, 7, 20, 21, 22, 23, 24, 25, 26, 27, 28, 29, 30 or 31.

19. The fusion polynucleotide of claim 1, wherein the complement C3d-binding polypeptide encoded by the fusion polynucleotide has at least 80% identity to the sequence of SEQ ID NO: 9 or SEQ ID NO: 10.

20. The fusion polynucleotide of claim 1, wherein the fragment antigen, antigen variant or fragment antigen variant further comprises an amino acid sequence from a second target protein antigen.

21. The fusion polynucleotide of claim 1, wherein (i) is positioned C-terminus of (ii).

22. The fusion polynucleotide of claim 1, wherein (i) and (ii) are separated by a nucleotide sequence encoding a linker.

23. The fusion polynucleotide of claim 10, wherein the MHC molecule is or comprises a MHC II molecule.

24. The fusion polynucleotide of claim 1, wherein the polynucleotide has at least 80% identity to the nucleotide sequence of any one of SEQ ID NOs: 47, 49, 50, 51, 52, 53, or 54.

25. The fusion polynucleotide of claim 1, wherein the complement C3d-binding polypeptide is or comprises domain III of the Sbi of *Staphylococcus aureus*, or a functional fragment or a variant thereof.

26. The fusion polynucleotide of claim 1, wherein the complement C3d-binding polypeptide is or comprises domain IV of the Sbi of *Staphylococcus aureus*, or a functional fragment or a variant thereof.