Claims

1. A polypeptide having an amino acid sequence comprising or consisting of:

    (a) FimH; or a variant, fragment and/or fusion of FimH, and

    (b) a donor-strand complementing amino acid sequence,

wherein (b) is downstream of (a) and wherein (b) comprises or consists of an amino acid sequence according to SEQ ID NO: 5.

2. A polypeptide comprising or consisting of an amino acid sequence X-(a)- L-(b)-Y , wherein "(a)" is a FimH polypeptide; or a variant, fragment and/or fusion of FimH; "L" is a first linker; "(b)" is a donor-strand complementing amino acid sequence, wherein (b) comprises or consists of an amino acid sequence according to SEQ ID NO: 5, "X" is an optional N-terminal amino acid sequence; "Y is an optional C-terminal amino acid sequence, wherein "Y" is not derived from FimC or FimH or a fragment thereof.

3. The polypeptide of claim 1 or 2 wherein (a) comprises or consists of:

    (A) the amino acid sequence of SEQ ID NO: 1 (Genbank Accession no: ELL41155.1 (FimH of E. coli J96)), SEQ ID NO: 2, SEQ ID NO: 100 (Genbank Accession no: ABG72591.1 (FimH of UPEC 536)) , SEQ ID NO: 101, SEQ ID NO: 102 (Genbank Accession no: AAN83822.1 (FimH of CFT073)), SEQ ID NO: 103, SEQ ID NO: 104 (Genbank Accession no: AJE58925.1 (FimH of E. coli 789)), SEQ ID NO: 105, SEQ ID NO: 106 (Genbank Accession No. AAC35864.1, corresponding to nucleic acid sequence AF089840.1 (FimH of IHE3034), or SEQ ID NO: 107,

    (B) an amino acid sequence comprising from 1 to 10 single amino acid alterations compared to SEQ ID NO: 1 (Genbank Accession no: ELL41155.1 (FimH of E. coli J96)), SEQ ID NO: 2 , SEQ ID NO: 100 (Genbank Accession no: ABG72591.1 (FimH of UPEC 536)) , SEQ ID NO: 101, SEQ ID NO: 102 (Genbank Accession no: AAN83822.1 (FimH of CFT073)), SEQ ID NO: 103, SEQ ID NO: 104 (Genbank Accession no: AJE58925.1 (FimH of E. coli 789)), SEQ ID NO: 105, SEQ ID NO: 106 (Genbank Accession No. AAC35864.1, corresponding to nucleic acid sequence AF089840.1 (FimH of IHE3034), or SEQ ID NO: 107, for example, 1, 2, 3, 4, 5, 6, 7, 8, 9 or 10 single amino acid alterations,

    (C) an amino acid sequence with at least 70% sequence identity with SEQ ID NO: 1 (Genbank Accession no: ELL41155.1 (FimH of E. coli J96)), SEQ ID NO: 2 , SEQ ID NO: 100 (Genbank Accession no: ABG72591.1 (FimH of UPEC 536)) , SEQ ID NO: 101, SEQ ID NO: 102 (Genbank Accession no: AAN83822.1 (FimH of CFT073)), SEQ ID NO: 103, SEQ ID NO: 104 (Genbank Accession no: AJE58925.1 (FimH of E. coli 789)), SEQ ID NO: 105, SEQ ID NO: 106 (Genbank Accession No. AAC35864.1, corresponding to nucleic acid sequence AF089840.1 (FimH of IHE3034), or SEQ ID

NO: 107, for example, 80%, 85%, 90%, 91%. 92%, 93%, 94%, 95%, 96%, 97%, 98% or 99% sequence identity, and/or

(D) a fragment of at least 10 consecutive amino acids from SEQ ID NO: 1 (Genbank Accession no: ELL41155.1 (FimH of E. coli J96)), SEQ ID NO: 2 , SEQ ID NO: 100 (Genbank Accession no: ABG72591.1 (FimH of UPEC 536)) , SEQ ID NO: 101, SEQ ID NO: 102 (Genbank Accession no: AAN83822.1 (FimH of CFT073)), SEQ ID NO: 103, SEQ ID NO: 104 (Genbank Accession no: AJE58925.1 (FimH of E. coli 789)), SEQ ID NO: 105, SEQ ID NO: 106 (Genbank Accession No. AAC35864.1, corresponding to nucleic acid sequence AF089840.1 (FimH of IHE3034), or SEQ ID NO: 107, for example, at least 20, 30, 40, 50, 60, 70, 80, 90, 100, 125, 150, 175, 200, 250, 275, 280, 290 or 300 consecutive amino acids.

4. The polypeptide of any one of the preceding claims wherein (b) is:

   (i) directly joined to the C-terminus of (a), or

   (ii) joined to the C-terminus of (a) via a first linker.

5. The polypeptide of any one of claims 2 or 4, (ii) wherein the first linker or "L" comprises or consists of 2-20 amino acids, for example, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19 or 20 amino acids.

6. The polypeptide of any one of claims 2, or 5 wherein the first linker begins with proline.

7. The polypeptide any one of claims 2, 4-6 wherein the first linker comprises or consists of polar amino acids, for example, wherein the first linker is entirely comprised of polar amino acids or, if the first linker begins with proline, the remainder of the amino acids are polar.

8. The polypeptide of any one of claims 2, 4-7 wherein the first linker comprises or consists of:

   (i) PGDGN **[SEQ ID NO: 7]**, or a variant or fusion thereof.

9. The polypeptide of any one of the preceding claims wherein the polypeptide comprises a nanoparticle domain at the N-terminus or C-terminus, optionally wherein "X" or "Y" comprise a nanoparticle domain.

10. The polypeptide of claim 9 wherein the nanoparticle domain is selected from the group consisting of:

   (i) ferritin (for example, **[SEQ ID NO: 15]** or [SEQ ID NO: 109] (*Helicobacter pylori*), **[SEQ ID NO: 16]** (*Escherichia coli*)), or any one of [SEQ ID NO: 149]- [SEQ ID NO: 152] (stabilized *Escherichia coli*)),or a variant and/or fragment thereof,

   (ii) iMX313 (for example **[SEQ ID NO: 17]**), or a variant and/or fragment thereof,

   (iii) mI3 (for example **[SEQ ID NO: 18]**), or a variant and/or fragment thereof,

   (iv) encapsulin (for example **[SEQ ID NO: 19]**), or a variant and/or fragment thereof, or

(v) Self-assembling viral coat proteins, such as *Acinetobacter* phage AP205 coat protein (NCBI Reference Sequence: NP_085472.1), Hepatitis B virus core protein (HBc) **[SEQ ID NO: 110]**, or bacteriophage Qβ **[SEQ ID NO: 111]**, or a variant and/or fragment thereof.

11. The polypeptide of anyone of the preceding claims, wherein the polypeptide comprises or consists of an amino acid sequence with at least 70% sequence identity to SEQ ID NO: 123 or SEQ ID NO:124, for example, 80%, 85%, 90%, 91%, 92%, 93%, 94%, 95%, 96%, 97%, 98% or 99% sequence identity to SEQ ID NO: 123 or SEQ ID NO:124.

12. A nucleic acid encoding a polypeptide according to any one of claims 1-11.

13. A cell comprising a nucleic acid of claim 12.

14. A vaccine comprising the polypeptide of any one of claims 1-11, or the nucleic acid of claim 12.

15. The vaccine of claim 14 further comprising an adjuvant, wherein the adjuvant comprises any one of: 3D-MPL, QS21 and liposomes, for example liposomes comprising cholesterol.

16. The vaccine of claim 15, wherein the adjuvant comprises 3D-MPL, QS21 and liposomes comprising cholesterol.

17. The polypeptide of any one of claims 1-11, the nucleic acid of claim 12, or the vaccine of claims 14-16 for use in medicine.

18. The polypeptide of any one of claims 1-11, the nucleic acid of claim 12, or the vaccine of claims 14-16 for use in raising an immune response in a mammal, for example, for treating and/or preventing one or more disease, optionally wherein the disease is a urinary tract infection.