What is Claimed is:

1. A prokaryotic host cell comprising:

a) nucleic acids that encode (i) glycosyltransferases that produce an oligosaccharide or polysaccharide repeat unit, wherein said repeat unit does not comprise a hexose at the reducing end, and wherein said oligosaccharide or polysaccharide repeat unit is derived from a donor oligosaccharide or polysaccharide repeat unit that comprises a hexose at the reducing end, and (ii) glycosyltransferases sufficient for synthesis of the donor oligosaccharide or polysaccharide repeat unit; and

b) a nucleic acid that encodes a carrier protein comprising an N-glycosylation consensus sequence; and

c) a nucleic acid that encodes an oligosaccharyl transferase; and

d) a nucleic acid that encodes a polymerase (*wzy*), wherein the polymerase catalyzes the production of a hybrid oligosaccharide or polysaccharide, wherein the hybrid oligosaccharide or polysaccharide (i) comprises a hexose monosaccharide derivative at the reducing end of the first repeat unit and (ii) comprises hexose monosaccharides at the reducing end of all other repeat units.

2. The host cell of claim 1, wherein said host cell is capable of producing a hybrid oligosaccharide or polysaccharide, wherein said hybrid oligosaccharide or polysaccharide is identical to the donor oligosaccharide or polysaccharide, with the exception that said hybrid oligosaccharide or polysaccharide comprises a hexose monosaccharide derivative at the reducing end of the first repeat unit in place of or in addition to the hexose monosaccharide normally present at the reducing end of the first repeat unit of the donor oligosaccharide or polysaccharide.

3. The host cell of any one of claims 1-2, wherein said host cell comprises (i) a glycosyltransferase that assembles a hexose monosaccharide derivative onto undecaprenyl pyrophosphate (UND-PP), optionally *wecA*, optionally from *E. coli*, and (ii) one or more glycosyltransferases capable of adding a monosaccharide to the hexose monosaccharide derivative assembled on UND-PP.

4. The host cell of claim 3, wherein said hexose monosaccharide derivative is any monosaccharide in which C-2 position is modified with an acetamido group, for example, N-acetylglucosamine (GlcNAc), N-acetylgalactoseamine (GalNAc), 2,4-Diacetamido-2,4,6-trideoxyhexose (DATDH), N-acetylfucoseamine (FucNAc), N-acetylquinovosamine (QuiNAc).

5. The host cell of any one of claims 3-4, wherein said one or more glycosyltransferases capable of adding a monosaccharide to the hexose monosaccharide derivative is the galactosyltransferase (*wfeD*) from *Shigella boyedii*, or the galactofuranosyltransferase (*wbeY*) from *E. coli* O28 or the galactofuranosyltransferase (*wfdK*) from *E. coli* O167, or are the galactofuranosyltransferase (*wbeY*) from *E. coli* O28 and the galactofuranosyltransferase (*wfdK*) from *E. coli* O167.

6. The host cell of any one of claims 1-5, wherein said glycosyltransferases sufficient for synthesis of the repeat units of the donor oligosaccharide or polysaccharide comprise (i) *wchL* and/or *wchM* from *S. pneumoniae* CP14, and/or (ii) *wciC*, *wciD*, *wciE*, and/or *wciF* from *S. pneumoniae* CP33F.

7. The host cell of any one of claims 1-4, wherein said host cell comprises (i) a glycosyltransferase that assembles a hexose monosaccharide derivative onto undecaprenyl pyrophosphate (UND-PP), optionally *wecA*, optionally from *E. coli*, and (ii) glycosyltransferases that assemble the donor oligosaccharide or polysaccharide repeat unit onto the hexose monosaccharide derivative, optionally comprising (i) a galactosyltransferase (*wciP*) optionally from *E. coli* O21, and/or (ii) a glucosyltransferase (*wciQ*) optionally from *E. coli* O21, and optionally further comprising an enzyme capable of modifying a monosaccharide, optionally an epimerase or a racemase, e.g. Z3206 from *E. coli* O157.

8. The host cell of claim 7, wherein said glycosyltransferases sufficient for synthesis of the repeat units of the donor oligosaccharide or polysaccharide comprise *wchL* and *wchM* from *S. pneumoniae* CP14.

9. The host cell of any one of claims 1-8, wherein said host cell comprises (i) a nucleic acid that encodes a capsular polysaccharide polymerase (*wzy*) or an O antigen polymerase (*wzy*), and

optionally said polymerase is from *Streptococcus pneumoniae*, optionally from *S. pneumoniae* CP1, CP2, CP3, CP4, CP5, CP6 (A and B), CP7 (A,B, C), CP8, CP9 (A, L,N, V), CP10 (A,B,C,F), CP11 (A, B,C,D,F), CP12(A,B,F), CP13, CP14, CP15(A,B,C,F), CP16(A,F), CP17(A,F), CP18(A,B,C,F), CP19(A,B,C,F), CP20, CP21, CP22(A,F), CP23(A,B,F), CP24(A,B,F), CP25(A,F), CP26, CP27, CP28(A,F), CP29, CP31, CP32(A,F), CP33(A,B,C,D,F), CP34, CP35(A,B,C,D,F), CP36, CP37, CP38, CP39, CP40, CP41(A,F), CP42, CP43, CP44, CP45, CP46, CP47(A,F), or CP48, and/or (ii) a nucleic acid that encodes a flippase (*wzx*), and optionally said flippase is from *Streptococcus pneumoniae*, optionally from *S. pneumoniae* CP1, CP2, CP3, CP4, CP5, CP6 (A and B), CP7 (A,B, C), CP8, CP9 (A, L,N, V), CP10 (A,B,C,F), CP11 (A, B,C,D,F), CP12(A,B,F), CP13, CP14, CP15(A,B,C,F), CP16(A,F), CP17(A,F), CP18(A,B,C,F), CP19(A,B,C,F), CP20, CP21, CP22(A,F), CP23(A,B,F), CP24(A,B,F), CP25(A,F), CP26, CP27, CP28(A,F), CP29, CP31, CP32(A,F), CP33(A,B,C,D,F), CP34, CP35(A,B,C,D,F), CP36, CP37, CP38, CP39, CP40, CP41(A,F), CP42, CP43, CP44, CP45, CP46, CP47(A,F), or CP48.

10. The host cell of any one of claims 1-9, wherein said polysaccharide is a capsular polysaccharide (CP), optionally from *Streptococcus pneumoniae*, optionally wherein said *S. pneumoniae* capsular polysaccharide is CP1, CP2, CP3, CP4, CP5, CP6 (A, B), CP7 (A, B, C), CP8, CP9 (A, L, N, V), CP10 (A, B, C, F), CP11 (A, B, C, D, F), CP12(A, B, F), CP13, CP14, CP15 (A, B, C, F), CP16 (A, F), CP17 (A, F), CP18 (A, B, C, F), CP19 (A, B, C, F), CP20, CP21, CP22 (A, F), CP23 (A, B, F), CP24 (A, B, F), CP25 (A, F), CP 26, CP27, CP28 (A, F), CP29, CP31, CP32 (A, F), CP33 (A, B, C, D, F), CP34, CP35 (A, B, C, D, F), CP36, CP37, CP38, CP39, CP40, CP41 (A, F), CP42, CP43, CP44, CP45, CP46, CP47 (A, F), or CP48 , or optionally from *Staphylococcus aureus*, optionally wherein said *S. aureus* capsular polysaccharide is CP5 or CP8, or optionally from *Streptococcus agalactiae* (GBS), optionally wherein said *Streptococcus agalactiae* capsular polysaccharide is *S. agalactiae* (group B, GBS) CPIa, CPIb, CPII, CPIII, CPIV, CPV, CPVI, CPVII, or CPVIII, or optionally from *Enterococcus faecalis*, optionally wherein said *Enterococcus faecalis* capsular polysaccharide is CPA, CPB, CPC, or CPD.

11. The host cell of any one of claims 1-10, wherein said oligosaccharyl transferase is heterologous to the host cell, optionally from *Campylobacter jejuni*, optionally wherein said

oligosaccharyl transferase is the *pglB* gene of *C. jejuni*, optionally wherein said *pglB* gene of *C. jejuni* is integrated into the host cell genome.

12. A hybrid oligosaccharide or polysaccharide having a structure

$$(B)_n—A\rightarrow$$

wherein A is an oligosaccharide repeat unit of a capsular saccharide of a Gram positive bacterial capsular saccharide selected from a Group A streptococcus capsular saccharide, a Group B streptococcus capsular saccharide, a *Streptococcus pneumoniae* capsular saccharide, Enterococcal capsular saccharide or a *Staphylococcus aureus* capsular saccharide containing at least 2, 3, 4, 5, 6, 7 or 8 monosaccharides, with a hexose monosaccharide derivative at the reducing end (indicated by arrow);

wherein B is an oligosaccharide repeat unit containing at least 2, 3, 4, 5, 6, 7 or 8 monosaccharides ;

wherein A and B are different oligosaccharide repeat units; and

wherein n is at least 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, or at least 20.

13. The hybrid oligosaccharide or polysaccharide of claim 12 wherein the B oligosaccharide repeat contains a hexose monosaccharide at the reducing end of the repeat, optionally wherein the hexose monosaccharide at the reducing end of the repeat is selected from the group consisting of glucose, galactose, rhamnose, arabinotol, fucose and mannose, and optionally wherein the oligosaccharide repeat unit of A and the oligosaccharide repeat unit of B differ only by containing a different monosaccharide at the reducing end of the repeat.

14. A bioconjugate comprising a carrier protein linked to the hybrid oligosaccharide or polysaccharide of any one of claims 12-13 and optionally the carrier protein is detoxified Exotoxin A of *P. aeruginosa* (EPA), CRM197, maltose binding protein (MBP), Diphtheria toxoid, Tetanus toxoid, detoxified hemolysin A of *S. aureus*, clumping factor A, clumping factor B, *E. coli* FimH, *E. coli* FimHC, *E. coli* heat labile enterotoxin,

detoxified variants of *E. coli* heat labile enterotoxin, Cholera toxin B subunit (CTB), cholera toxin, detoxified variants of cholera toxin, *E. coli* Sat protein, the passenger domain of *E. coli* Sat protein, *Streptococcus pneumoniae* Pneumolysin and detoxified variants thereof, *C. jejuni* AcrA, a *C. jejuni* natural glycoprotein, PcrV (aka LcrV,EspA, SseB), PopB (YopB, YopD, FliC), or OprF, OprI.

15. The bioconjugate of claim 14 wherein the hexose monosaccharide derivative is any monosaccharide in which C-2 position is modified with an acetamido group such as N-acetylglucosamine (GlcNAc), N-acetylgalactoseamine (GalNAc), 2,4-Diacetamido-2,4,6-trideoxyhexose (DATDH). N-acetylfucoseamine (FucNAc), or N-acetylquinovosamine (QuiNAc).

16. The bioconjugate of any one of claims 14-15 wherein the hybrid oligosaccharide or polysaccharide is identical to a Gram positive bacterial capsular saccharide (optionally a Group A streptococcus capsular saccharide, a Group B streptococcus capsular saccharide e.g. a *Streptococcus agalactiae* (Group B Streptococcus) serotype Ia, Ib, II, III, IV, V, VI, VII or VIII capsular saccharide, a *Streptococcus pneumoniae* capsular saccharide e.g. a *Streptococcus pneumoniae* serotype 8, 12F, 14, 15A, 16F, 22F, 23A, 24F, 31, 33F, 35B or 38 capsular saccharide, Enterococcal capsular saccharide e.g. a *Enterococcus faecalis* serotype A, B, C or D capsular saccharide or a *Staphylococcus aureus* capsular saccharide e.g. a *S. aureus* serotype 5 or 8 capsular saccharide), with the exception of the fact that the hybrid oligosaccharide or polysaccharide comprises a hexose monosaccharide derivative at the reducing end of the first repeat unit in place of the hexose monosaccharide normally present at the reducing end of the first repeat of said Gram positive bacterial capsular saccharide.

17. A method of producing a bioconjugate comprising a carrier protein N-linked to an oligosaccharide or polysaccharide that does not comprise a hexose at the reducing end of the first repeat unit, said method comprising (i) culturing the host cell of any one of claims 1-11 under conditions suitable for the production of proteins and (ii) isolating said bioconjugate.

18. A bioconjugate according to any one of claims 14-16, produced by the method of claim 17.

19. A composition comprising the bioconjugate of any one of claims 14-16 or 18 for use in the treatment or prevention of a bacterial infection in a subject, wherein the subject is a human.

20. Use of a composition comprising the bioconjugate of any one of claims 14-16 or 18 in the manufacture of a medicament for the treatment or prevention of a bacterial infection in a subject, wherein the subject is a human.