

Supplementary material:

Table 1: Meningococcal serogroup B vaccines investigated in Clinical trials

Components/Vaccine	References
B polysaccharide	[12]
N-propionylated B polysaccharide	[13]
Outer membrane protein and B polysaccharide	[14]
Outer membrane vesicle, C polysaccharide and 65-95KDa enveloped proteins	[15], [16], [17]
Outer membrane vesicle	[18-24]
Outer membrane protein and C polysaccharide	[25-30]
Bivalent Outer membrane vesicle	[31, 32]
Intranasal Outer membrane vesicle	[33-35]
NspA	[36]
2fusion proteins, GNA 2091-fHbp variant1 and GNA 2132-GNA1030 and NadA	[37]

Table 2: Population coverage rate (%) of MHC Class I peptides as predicted by IEDB server

Population/Area	Population Coverage rate							
	EKDLEKSVL	RATGIKVKL	KFVAFLASK	LVKVVSVQK	KTVDAQDLLK	DAQDLLKGL	ATDMRELLK	HGKRKIISI
Australia	90.70	92.68	91.22	78.71	91.49	91.42	65.44	92.38
Europe	97.21	99.03	98.50	98.07	99.28	98.95	81.34	97.51
North Africa	53.30	62.67	59.70	48.94	61.69	56.21	16.67	65.70
North America	97.07	98.51	98.14	90.77	98.35	97.66	86.40	96.75
North East Asia	86.25	89.87	90.35	87.41	93.11	91.15	58.81	91.54
Oceania	95.08	96.13	95.19	86.16	95.61	94.86	70.12	96.64
Other	95.73	96.92	96.87	95.32	97.81	96.75	75.05	95.52
South America	89.33	92.09	92.04	91.92	92.31	92.27	83.23	86.88
South East Asia	92.84	95.54	93.51	89.59	96.89	95.68	71.21	95.99
South West Asia	92.71	92.42	94.91	93.99	95.46	93.78	55.62	94.15
Sub-Saharan Africa	86.24	87.16	87.02	89.37	91.49	89.42	48.09	85.14
AVERAGE	78.72	81.26	80.69	75.54	83.13	81.62	59.55	81.00
Standard Deviation	30.30	29.25	29.22	29.00	29.31	29.32	28.29	28.99

Table 3: Population coverage rate (%) of MHC Class II peptides as predicted by IEDB server.

Population/Area	Population coverage rate (%)	
	KPYAKNSVALQAV	VQKAVGSILVAG
Australia	43.75	47.95
Europe	43.53	52.92
North Africa	67.90	78.74
North America	38.52	36.57
North East Asia	71.54	76.15
Oceania	61.80	65.97
Other	67.88	79.47
South America	21.09	23.77
South East Asia	16.04	16.95
South West Asia	64.97	79.10
Sub-Saharan Africa	44.82	62.01
AVERAGE	24.41	27.92
Standard Deviation	28.93	33.33

Table 4: List of MHC Class I T-cell epitopes with their corresponding HLA alleles, as predicted by Sypfeithi, nHLAPred, ProPred1, NetCTL and immunogenicity by POPI, showing the selected 10-mer epitope ¹⁴⁸KTVDAQDLLK¹⁵⁷ (high) and 9-mer epitope ⁴⁴RATGIKVKL⁵² (moderate) immunogenicity and that bind to maximum no. of HLA molecules obtained from FrpB and FbpA proteins respectively.

Sl. No	Epitope core (9-mer)	Protein (Acc.no)	Amino Acid position	Immunogenicity as predicted by POPI server	Total No of binding HLA molecules	HLA alleles predicted to bind to the epitope
1	EKDLEKSVL	FbpA (NMB0634)	136	High Immunogenic	91	HLA A1, HLA A2, HLA A*0201, HLA A*0205, HLA A24, HLA A*3302, HLA A68.1, HLA A20, HLA A20Cw, HLA A2.1, HLA B14, HLA B*2702, HLA B*2705, HLA B*3501, HLA B*3701, HLA B*3801, HLA B*3901, HLA B*3902, HLA B40, HLA B*4403, HLA B*5101, HLA B*5102, HLA B*5103, HLA B*5201, HLA B*5801, HLA B60, HLA B61, HLA B7, HLA B*0702, HLA B8, HLA Cw*0301, HLA Cw*0401, HLA Cw*0602, HLA Cw*0702, HLA A*26, HLA B*3902, HLA B*4401, HLA A*0111, HLA A*0201, HLA A*03, HLA A*1101, HLA A*2402, HLA A*26, HLA B*0602, HLA B*1402, HLA B*1510, HLA B*18, HLA B*2705, HLA B*3801, HLA B*3901, HLA B*3902, HLA A*2601, HLA A*2602, HLA A*2603, HLA A*2605, HLA A*2606, HLA A*2608, HLA A*2609, HLA A*2611, HLA A*2612, HLA A*2618,

2	RATGIKVKL	FbpA (NMB0634)	44	Moderate Immunogenic	91	HLA B*0801, HLA B*0803, HLA B*0804, HLA B*0805, HLA B*39, HLA B*3902, HLA B*3903, HLA B*3905, HLA-B*3906, HLA-B*3907, HLA-B*3908, HLA-B*3910, HLA-B*3911, HLA-B*3913, HLA B*3915, HLA B*2702, HLA B*2703, HLA B*2704, HLA B*2705, HLA B*2706, HLA B*2707, HLA B*2709, HLA B*2711, HLA B*2714, HLA B*4701, HLA B*4901
3	KFVAFLASK	FbpA (NMB0634)	268	High Immunogenic	94	HLA A1, HLA A2, HLA A*0201, HLA A*0205, HLA A24, HLA A*3302, HLA A 68.1, HLA A20, HLA A20Cw, HLA A2.1, HLA B14, HLA B*2702, HLA B*2705,HLA B*3501, HLA B*3701, HLA B*3801, HLA B*3901, HLA B*3902, HLA B40, HLA B*4403, HLA B*5101, HLA B*5102, HLA B*5103, HLA B*5201, HLA B*5801, HLA B60, HLA B61, HLA B7, HLA B*0702, HLA B8, HLA Cw*0301, HLA Cw*0401, HLA Cw*0602, HLA Cw*0702, HLA A*1101, HLA A3, HLA A*3101, HLA B*5401, HLA B*51, HLA B62HLA A*2402, HLA A*6801, HLA B*0702, HLA B*1402, HLA B*1501, HLA B*1510, HLA B*18, HLA B*2705, HLA B*2709, HLA B*3901, HLA B*3902, HLA B*4001, HLA B*4701, HLA B*4901, HLA B*0801, HLA B*0803, HLA B*0804, HLA B*0805, HLA B*39, HLA B*3903, HLA B*3905, HLA B*3906, HLA B*3907, HLA B*3908, HLA B*3910, HLA B*3911, HLA B*3913, HLA B*3915, HLA B*2702, HLA B*2703, HLA B*2704, HLA B*2706, HLA B*2707, HLA B*2711, HLA B*2714, HLA A*2402, HLA A*240201, HLA B*4402, HLA B*4404, HLA B*4404, HLA B*4405, HLA B*4406, HLA B*4407, HLA B*4408, HLA B*4410, HLA B*4415, HLA B*4426
4	LVKVVSVQK	FrpB (NMB1988)	121	High Immunogenic	99	HLA A1, HLA A2, HLA A*0201, HLA A*0205, HLA A24, HLA A*3302, HLA A68.1, HLA A20, HLA A20Cw, HLA A2.1, HLA B14, HLA B*2702, HLA B*2705,HLA B*3501, HLA B*3701, HLA B*3801, HLA B*3901, HLA B*3902, HLA B40, HLA B*4403, HLA B*5101, HLA B*5102, HLA B*5103, HLA B*5201, HLA B*5801, HLA B60, HLA B61, HLA B7, HLA B8, HLA Cw*0301, HLA Cw*0401, HLA Cw*0602, HLA Cw*0702, HLA A*1101, HLA A*3101, HLA B*62, HLA A*03, HLA A*01, HLA A*0201, HLA A*6801, HLA A*26, HLA B*08, HLA B*0702, HLA B*1402, HLA B*18, HLA B*5001, HLA A*0301, HLA A*0302, HLA A*2402, HLA A*240201, HLA A*2601, HLA A*2602, HLA A*2603, HLA A*2605, HLA A*2608, HLA A*2609, HLA A*2611, HLA A*2612, HLA A*2618, HLA B*2702, HLA B*2703, HLA B*2704, HLA B*2705, HLA B*2706, HLA B*2707, HLA B*2709, HLA B*2711, HLA B*2714, HLA B*39, HLA B*3901, HLA B*3902, HLA B*3903, HLA B*3905, HLA B*3906, HLA B*3907, HLA B*3908, HLA B*3910, HLA B*3911, HLA B*3913, HLA B*3915, HLA B*4402,HLA B*4404, HLA B*4404, HLA B*4405, HLA B*4406, HLA B*4407, HLA B*4408, HLA B*4410, HLA B*4415, HLA B*4426, HLA B*5802

5	KTVDAQDLLK	FrpB (NMB1988)	148	High Immunogenic	121	HLA A1, HLA A2, HLA A*0201, HLA A*0205, HLA A24, HLA A*3302, HLA A68.1, HLA A20, HLA A20Cw, HLA B14, HLA B*2702, HLA B*2705, HLA B*3501, HLA B*3701, HLA B*3801, HLA B*3901, HLA B*3902, HLA B40, HLA B*4403, HLA B*5101, HLA B*5102, HLA B*5103, HLA B*5201, HLA B*5801, HLA B60, HLA B61, HLA B7, HLA Cw*0301, HLA Cw*0401, HLA Cw*0602, HLA Cw*0702, HLA A*1101, HLA A*3101, HLA A3, HLA B*5401, HLA B*51, HLA B 62, HLA A*3301, HLA A*6801, HLA B*0702, HLA B*1402, HLA B*1501, HLA B*1510, HLA B*2705, HLA A*0203, HLA A*01, HLA A*03, HLA A*1101, HLA A*2402, HLA A*26, HLA A*6801, HLA B*08, HLA B*1402, HLA A*0201, HLA A*0202, HLA A*0203, HLA A*0204, HLA A*0205, HLA A*0207, HLA A*0208, HLA A*0210, HLA A*0211, HLA A*0212, HLA A*0213, HLA A*0214, HLA *0216, HLA A*0217, HLA A*0219, HLA A*0220, HLA A*0222, HLA A*0224, HLA A*0225, HLA A*0226, HLA A*0228, HLA A*0233, HLA A*0234, HLA A*0236, HLA A*0240, HLA A*0244, HLA A*0245, HLA A*0246, HLA A*0301, HLA A*0302, HLA A*2402, HLA A*240201, HLA A*2601, HLA A*2602, HLA A*2603, HLA A*2605, HLA A*2608, HLA A*2609, HLA A*2611, HLA A*2612, HLA A*2618, HLA B*0704, HLA B*0705, HLA B*0707, HLA B*0712, HLA B*0717, HLA B*0720, HLA B*0726, HLA B*0801, HLA B*0803, HLA B*0804, HLA B*0805, HLA B*4402, HLA B*4403, HLA B*4404, HLA B*4405, HLA B*4406, HLA B*4407, HLA B*4408, HLA B*4410, HLA B*4415, HLA B*4426, HLA B*5802
6	DAQDLLKGL	FrpB (NMB1988)	151	High Immunogenic	113	HLA A1, HLA A2, HLA A*0201, HLA A*0205, HLA A24, HLA A*3302, HLA A68.1, HLA A20, HLA A20Cw, HLA B14, HLA B*2702, HLA B*2705, HLA B*3501, HLA B*3701, HLA B*3801, HLA B*3901, HLA B*3902, HLA B40, HLA B*4403, HLA B*5101, HLA B*5102, HLA B*5103, HLA B*5201, HLA B*5801, HLA B60, HLA B61, HLA B7, HLA B*0702, HLA B8, HLA Cw*0301, HLA Cw*0401, HLA Cw*0602, HLA Cw*0702, HLA A*1101, HLA A3, HLA A*3101, HLA B*5401, HLA B62, HLA A*0203, HLA B*3701, HLA B*3801, HLA B*3901, HLA B*3902, HLA B60, HLA A*03, HLA A*2402, HLA A*6801, HLA A*08, HLA A*1402, HLA A*2705, HLA A*0203, HLA B40, HLA A*03, HLA A*2402, HLA A*26, HLA A*6801, HLA B*1402, HLA A*0202, HLA A*0204, HLA A*0205, HLA A*0207, HLA A*0208, HLA A*0210, HLA A*0211, HLA A*0212, HLA A*0213, HLA A*0214, HLA A*0216, HLA A*0217, HLA A*0219, HLA A*0220, HLA A*0222, HLA A*0224, HLA A*0225, HLA A*0226, HLA A*0228, HLA A*0233, HLA A*0234, HLA A*0236, HLA A*0240, HLA A*0244, HLA A*0245, HLA A*0246, HLA A*0301, HLA A*0302, HLA A*240201, HLA B*0702, HLA B*0704, HLA B*0705, HLA B*0707, HLA B*0712, HLA B*0717, HLA B*0720, HLA B*0726, HLA B*0801, HLA B*0803, HLA B*0804, HLA B*0805, HLA B*4402, HLA B*4403, HLA B*4404, HLA B*4405, HLA B*4406, HLA B*4407, HLA B*4408, HLA B*4410, HLA B*4415, HLA B*4426, HLA B*5802
7	ATDMRELLK	FrpB (NMB1988)	60	High Immunogenic	62	HLA A*01, HLA A*2402, HLA A*26, HLA B*2705, HLA A*0201, HLA A*0202, HLA A*0203, HLA A*0204, HLA A*0205, HLA A*0207, HLA A*0208, HLA A*0210, HLA A*0211, HLA A*0212, HLA A*0213, HLA A*0214, HLA A*0216, HLA A*0217, HLA A*0219, HLA A*0220, HLA A*0222, HLA A*0224, HLA A*0225, HLA A*0226, HLA A*0228, HLA A*0233, HLA A*0234, HLA A*0236, HLA A*0240, HLA A*0244, HLA A*0245, HLA A*0246, HLA A*0301, HLA A*0302, HLA A*240201, HLA B*0702, HLA B*0704, HLA B*0705, HLA B*0707, HLA B*0712, HLA B*0717, HLA B*0720, HLA B*0726, HLA B*0801, HLA B*0803, HLA B*0804, HLA B*0805, HLA B*4402, HLA B*4403, HLA B*4404, HLA B*4405, HLA B*4406, HLA B*4407, HLA B*4408, HLA B*4410, HLA B*4415, HLA B*4426, HLA B*5802
8	HGKRGIIISI	FrpB (NMB1988)	488	Moderate Immunogenic	81	HLA A1, HLA A2, HLA A*0201, HLA A*0205, HLA A24, HLA A*3302, HLA A68.1, HLA A20, HLA A20Cw, HLA A2.1, HLA B14, HLA B*2702, HLA B*2705, HLA B*3501, HLA B*3701, HLA B*3801, HLA B*3901, HLA B*3902, HLA B40, HLA B*4403, HLA B*5101, HLA B*5102, HLA B*5103, HLA B*5201, HLA B*5801, HLA B60, HLA B61, HLA B7, HLA B*0702, HLA B8, HLA Cw*0301, HLA Cw*0401, HLA Cw*0602, HLA Cw*0702, HLA A*1101, HLA A3, HLA A*3101, HLA B*5401, HLA B*51, HLA B62, HLA B*5201, HLA B*4402, HLA B*4501, HLA B*4701, HLA B*4901, HLA B*5001, HLA B*2709, HLA B*4101, HLA B*4001,

HLA A*2402, HLA A*240201, HLA A*2601, HLA A*2602, HLA A*2603, HLA A*2605, HLA A*2608, HLA A*2609, HLA A*2611, HLA A*2612, HLA A*2618, HLA B*0702, HLA B*0704, HLA B*0705, HLA B*0707, HLA B*0712, HLA B*0717, HLA B*0720, HLA B*0726, HLA B*4404, HLA B*4405, HLA B*4406, HLA B*4407, HLA B*4408, HLA B*4410, HLA B*4415

Table 5: List of MHC Class II T-cell epitopes with their corresponding HLA alleles, as predicted by Syfpeithi, nHLAPred, ProPred1, NetCTL and immunogenicity by POPI, showing the selected 12-mer epitope ⁶²⁹VQKAVGSILVAG⁶⁴⁰ with high immunogenicity and that binds to maximum no. of HLA molecules from FrpB protein.

Sl. No	Epitope core (9-mer)	Protein (Acc.no)	Amino Acid position	Immunogenicity as predicted by POPI server	Total No of binding HLA molecules	HLA alleles predicted to bind to the epitope
1	KPYAKNSVALQAV	FbpA (NMB0634)	192-204	High	42/51	HLA DRB1*0305, HLA DRB1*0306, HLA DRB1*0307, HLA DRB1*0308, HLA DRB1*0309, HLA DRB1*0401, HLA DRB1*0402, HLA DRB1*0404, HLA DRB1*0405, HLA DRB1*0408, HLA DRB1*0410, HLA DRB1*0421, HLA DRB1*0423, HLA DRB1*0426, HLA DRB1*0701, HLA DRB1*0703, HLA DRB1*0801, HLA DRB1*0802, HLA DRB1*0804, HLA DRB1*0806, HLA DRB1*0814, HLA DRB1*1106, HLA DRB1*1107, HLA DRB1*1114, HLA DRB1*1121, HLA DRB1*1128, HLA DRB1*1302, HLA DRB1*1304, HLA DRB1*1305, HLA DRB1*1307, HLA DRB1*1311, HLA DRB1*1321, HLA DRB1*1322, HLA DRB1*1323, HLA DRB1*1327, HLA DRB1*1328, HLA DRB1*1501, HLA DRB1*1502, HLA DRB1*1506, HLA DRB1*0101, HLA DRB1*0105, HLA DRB1*0102
2	VQKAVGSILVAG	FrpB (NMB1988)	629-640	High	48/51	HLA DRB1*0101, HLA DRB1*0102, HLA DRB1*0301, HLA DRB1*0305, HLA DRB1*0306, HLA DRB1*0307, HLA DRB1*0308, HLA DRB1*0309, HLA DRB1*0311, HLA DRB1*0401, HLA DRB1*0402, HLA DRB1*0404, HLA DRB1*0405, HLA DRB1*0408, HLA DRB1*0421, HLA DRB1*0423, HLA DRB1*0426, HLA DRB1*0701, HLA DRB1*0703, HLA DRB1*0801, HLA DRB1*0802, HLA DRB1*0804, HLA DRB1*0806, HLA DRB1*0814, HLA DRB1*1106, HLA DRB1*1107, HLA DRB1*1114, HLA DRB1*1120, HLA DRB1*1121, HLA DRB1*1128, HLA DRB1*1301, HLA DRB1*1302, HLA DRB1*1304, HLA DRB1*1305, HLA DRB1*1307, HLA DRB1*1311, HLA DRB1*1321, HLA DRB1*1322, HLA DRB1*1323, HLA DRB1*1327, HLA DRB1*1328, HLA DRB1*1501, HLA DRB1*1502, HLA DRB1*1506, HLA DRB1*0101, HLA DRB1*0105, HLA DRB1*1505, HLA DRB1*1506