

Supplementary Information 6. Differential analysis of single cell gene expression of CD4⁺ T cells pre

d. Patient 1 and 4 intersection

Gene	Gene_Name	Group in which gene is upregulated	Patient
			% cells expressing (Pre)
RPL39	Ribosomal Protein L39	Post	9.7
TIGIT	T-Cell Immunoreceptor With Ig And ITIM Dom:	Post	0
PET100	PET100 Homolog	Post	0
LYST	Lysosomal Trafficking Regulator	Post	1.4
CYBA	Cytochrome B-245 Alpha Chain	Post	1.4
TMSB4X	Thymosin Beta 4, X-Linked	Post	100
MMS19	MMS19 Homolog, Cytosolic Iron-Sulfur Assem	Post	1.4
HLA-DPA1	Major Histocompatibility Complex, Class II, DP	Post	1.4
TTC7A	Tetratricopeptide Repeat Domain 7A	Post	1.4
TOX	Thymocyte Selection Associated High Mobility	Post	2.8
METTL8	Methyltransferase Like 8	Post	1.4
PCMT1	Protein-L-Isoaspartate (D-Aspartate) O-Methyl	Post	2.8
DAXX	Death Domain Associated Protein	Post	2.8
SMARCB1	SWI/SNF Related, Matrix Associated, Actin Dep	Post	1.4
DYNC1I2	Dynein Cytoplasmic 1 Intermediate Chain 2	Post	2.8
ST8SIA1	ST8 Alpha-N-Acetyl-Neuraminide Alpha-2,8-Sia	Post	4.2
RASSF2	Ras Association Domain Family Member 2	Post	2.8
BTBD2	BTB Domain Containing 2	Post	1.4
CISH	Cytokine Inducible SH2 Containing Protein	Post	2.8
TMSB10	Thymosin Beta 10	Post	88.9
CNOT6	CCR4-NOT Transcription Complex Subunit 6	Post	2.8
MARCKSL1	MARCKS Like 1	Post	2.8
XPNPEP1	X-Prolyl Aminopeptidase 1	Post	2.8
SRF	Serum Response Factor	Post	2.8
CARS2	Cysteinyl-TRNA Synthetase 2, Mitochondrial (F	Post	4.2
TOB2	Transducer Of ERBB2, 2	Post	5.6
C7orf73		Post	1.4
PRR5L	Proline Rich 5 Like	Post	4.2
HDAC6	Histone Deacetylase 6	Post	4.2
CD52	CD52 Molecule	Post	81.9
PFN1	Profilin 1	Post	75
SYNGAP1	Synaptic Ras GTPase Activating Protein 1	Post	4.2
SYT11	Synaptotagmin 11	Post	1.4
MB21D1	Mab-21 Domain Containing 1	Post	1.4
ARHGAP35	Rho GTPase Activating Protein 35	Post	4.2
MRPL14	Mitochondrial Ribosomal Protein L14	Post	4.2
ELAVL1	ELAV Like RNA Binding Protein 1	Post	4.2
LRRC8D	Leucine Rich Repeat Containing 8 Family Mem	Post	1.4
SNX27	Sorting Nexin Family Member 27	Post	4.2
TMEM204	Transmembrane Protein 204	Post	2.8

CDC40	Cell Division Cycle 40	Post	5.6
CFL1	Cofilin 1	Post	73.6
ATG3	Autophagy Related 3	Post	5.6
GGCX	Gamma-Glutamyl Carboxylase	Post	1.4
RDX	Radixin	Post	5.6
ACTB	Actin Beta	Post	93.1
COLGALT1	Collagen Beta(1-O)Galactosyltransferase 1	Post	2.8
ZNF592	Zinc Finger Protein 592	Post	4.2
IMPDH1	Inosine Monophosphate Dehydrogenase 1	Post	2.8
RPS19BP1	Ribosomal Protein S19 Binding Protein 1	Post	5.6
BRE	Brain And Reproductive Organ-Expressed (TNF	Post	2.8
IFITM2	Interferon Induced Transmembrane Protein 2	Post	47.2
MYEF2	Myelin Expression Factor 2	Post	2.8
EIF4E	Eukaryotic Translation Initiation Factor 4E	Post	4.2
MYL6	Myosin Light Chain 6	Post	59.7
HLA-A	Major Histocompatibility Complex, Class I, A	Post	97.2
NPDC1	Neural Proliferation, Differentiation And Contr	Post	4.2
FAM89B	Family With Sequence Similarity 89 Member B	Post	5.6
RTN3	Reticulon 3	Post	4.2
HDAC10	Histone Deacetylase 10	Post	2.8
RPA2	Replication Protein A2	Post	5.6
C4orf48		Post	1.4
C16orf87		Post	4.2
TOR1A	Torsin Family 1 Member A	Post	1.4
RCBTB2	RCC1 And BTB Domain Containing Protein 2	Post	4.2
CTBS	Chitobiase	Post	6.9
RP11-343N15.5		Post	2.8
CEP192	Centrosomal Protein 192	Post	4.2
CPEB4	Cytoplasmic Polyadenylation Element Binding	Post	4.2
CCDC50	Coiled-Coil Domain Containing 50	Post	1.4
FRG1	FSHD Region Gene 1	Post	4.2
LUZP1	Leucine Zipper Protein 1	Post	4.2
LDLRAD4	Low Density Lipoprotein Receptor Class A Dorr	Post	5.6
MTRNR2L1	MT-RNR2-Like 1	Post	25
ARPC2	Actin Related Protein 2/3 Complex Subunit 2	Post	65.3
ASNA1	ArsA Arsenite Transporter, ATP-Binding, Homoc	Post	2.8
ATP6V1B2	ATPase H+ Transporting V1 Subunit B2	Post	4.2
PIAS2	Protein Inhibitor Of Activated STAT 2	Post	4.2
DTX3L	Deltex E3 Ubiquitin Ligase 3L	Post	5.6
FAM160B2	Family With Sequence Similarity 160 Member	Post	5.6
TRIM26	Tripartite Motif Containing 26	Post	5.6
FBXO45	F-Box Protein 45	Post	4.2
IARS	Isoleucyl-TRNA Synthetase	Post	5.6
STAMBP	STAM Binding Protein	Post	2.8
LANCL1	LanC Like 1	Post	5.6
PIGT	Phosphatidylinositol Glycan Anchor Biosynthes	Post	4.2
IFNAR1	Interferon Alpha And Beta Receptor Subunit 1	Post	4.2

C11orf48		Post	4.2
HLA-C	Major Histocompatibility Complex, Class I, C	Post	97.2
HSPBP1	HSPA (Hsp70) Binding Protein 1	Post	2.8
KLF6	Kruppel Like Factor 6	Post	81.9
CSNK2A1	Casein Kinase 2 Alpha 1	Post	6.9
C12orf75		Post	5.6
EZH2	Enhancer Of Zeste 2 Polycomb Repressive Cor	Post	4.2
KLF7	Kruppel Like Factor 7	Post	8.3
API5	Apoptosis Inhibitor 5	Post	6.9
SP2	Sp2 Transcription Factor	Post	5.6
AHNAK	AHNAK Nucleoprotein	Post	50
AL592183.1		Post	4.2
LPCAT4	Lysophosphatidylcholine Acyltransferase 4	Post	2.8
UQCRC1	Ubiquinol-Cytochrome C Reductase Core Prote	Post	4.2
CD74	CD74 Molecule	Post	30.6
GDPD5	Glycerophosphodiester Phosphodiesterase Do	Post	4.2
DMXL1	Dmx Like 1	Post	5.6
ZEB2	Zinc Finger E-Box Binding Homeobox 2	Post	2.8
CPEB2	Cytoplasmic Polyadenylation Element Binding	Post	0
WHSC1	Wolf-Hirschhorn Syndrome Candidate 1	Post	4.2
BAHD1	Bromo Adjacent Homology Domain Containin	Post	5.6
PREP	Prolyl Endopeptidase	Post	1.4
SLAMF1	Signaling Lymphocytic Activation Molecule Far	Post	5.6
IDH3G	Isocitrate Dehydrogenase 3 (NAD(+)) Gamma	Post	5.6
PBDC1	Polysaccharide Biosynthesis Domain Containin	Post	4.2
TRAPPC2	Trafficking Protein Particle Complex 2	Post	2.8
HCP5	HLA Complex P5 (Non-Protein Coding)	Post	5.6
NDUFS7	NADH:Ubiquinone Oxidoreductase Core Subur	Post	4.2
MRPL24	Mitochondrial Ribosomal Protein L24	Post	4.2
EIF4H	Eukaryotic Translation Initiation Factor 4H	Post	5.6
NIPSNAP1	Nipsnap Homolog 1 (C. Elegans)	Post	5.6
S100A4	S100 Calcium Binding Protein A4	Post	59.7
C18orf8		Post	2.8
KIF20B	Kinesin Family Member 20B	Post	6.9
TWISTNB	TWIST Neighbor	Post	8.3
SLC39A13	Solute Carrier Family 39 Member 13	Post	5.6
DFFA	DNA Fragmentation Factor Subunit Alpha	Post	6.9
DPYSL2	Dihydropyrimidinase Like 2	Post	4.2
TP53INP1	Tumor Protein P53 Inducible Nuclear Protein 1	Post	6.9
AP2S1	Adaptor Related Protein Complex 2 Sigma 1 Su	Post	5.6
MRPL51	Mitochondrial Ribosomal Protein L51	Post	4.2
BFAR	Bifunctional Apoptosis Regulator	Post	8.3
GPALPP1	GPALPP Motifs Containing 1	Post	2.8
DDX58	DEXD/H-Box Helicase 58	Post	2.8
FAM222B	Family With Sequence Similarity 222 Member	Post	6.9
GMCL1	Germ Cell-Less, Spermatogenesis Associated 1	Post	5.6
PSMD14	Proteasome 26S Subunit, Non-ATPase 14	Post	5.6

XPO4	Exportin 4	Post	6.9
FIBP	FGF1 Intracellular Binding Protein	Post	2.8
KIAA1468	KIAA1468	Post	8.3
MTOR	Mechanistic Target Of Rapamycin	Post	5.6
MON1B	MON1 Homolog B, Secretory Trafficking Assoc	Post	6.9
BCR	BCR, RhoGEF And GTPase Activating Protein	Post	4.2
GSTK1	Glutathione S-Transferase Kappa 1	Post	43.1
ANO6	Anoctamin 6	Post	6.9
ORAI2	ORAI Calcium Release-Activated Calcium Modu	Post	5.6
COTL1	Coactosin Like F-Actin Binding Protein 1	Post	41.7
BRAP	BRCA1 Associated Protein	Post	5.6
TMEM14C	Transmembrane Protein 14C	Post	6.9
RBM15	RNA Binding Motif Protein 15	Post	6.9
PYCARD	PYD And CARD Domain Containing	Post	5.6
DDX1	DEAD/H-Box Helicase 1	Post	6.9
SAT2	Spermidine/Spermine N1-Acetyltransferase Fa	Post	5.6
SCAP	SREBF Chaperone	Post	5.6
ARPC1B	Actin Related Protein 2/3 Complex Subunit 1B	Post	40.3
USO1	USO1 Vesicle Transport Factor	Post	6.9
RPL17	Ribosomal Protein L17	Post	4.2
HIVEP3	Human Immunodeficiency Virus Type I Enhanc	Post	5.6
MAF	MAF BZIP Transcription Factor	Post	25
RPS7	Ribosomal Protein S7	Post	73.6
INPPL1	Inositol Polyphosphate Phosphatase Like 1	Post	6.9
GCDH	Glutaryl-CoA Dehydrogenase	Post	2.8
LAP3	Leucine Aminopeptidase 3	Post	8.3
ATP5E	ATP Synthase, H+ Transporting, Mitochondrial	Post	62.5
RRP7A	Ribosomal RNA Processing 7 Homolog A	Post	4.2
MIAT	Myocardial Infarction Associated Transcript (N	Post	19.4
PGM2L1	Phosphoglucomutase 2 Like 1	Post	5.6
MOB2	MOB Kinase Activator 2	Post	5.6
GTF3C1	General Transcription Factor IIIC Subunit 1	Post	2.8
CEP164	Centrosomal Protein 164	Post	6.9
LINC00892	Long Intergenic Non-Protein Coding RNA 892	Post	2.8
42987		Post	52.8
SCAND1	SCAN Domain Containing 1	Post	2.8
IFITM1	Interferon Induced Transmembrane Protein 1	Post	51.4
F5	Coagulation Factor V	Post	0
PPFIA1	PTPRF Interacting Protein Alpha 1	Post	5.6
CXCR4	C-X-C Motif Chemokine Receptor 4	Pre	98.6
ELL2	Elongation Factor For RNA Polymerase II 2	Pre	20.8
NELL2	Neural EGFL Like 2	Pre	19.4
EEF1A1	Eukaryotic Translation Elongation Factor 1 Alpl	Pre	66.7
MTRNR2L12	MT-RNR2-Like 12	Pre	90.3
ILKAP	ILK Associated Serine/Threonine Phosphatase	Pre	26.4
SATB1	SATB Homeobox 1	Pre	50
AEN	Apoptosis Enhancing Nuclease	Pre	12.5

CAPN7	Calpain 7	Pre	11.1
BMI1	BMI1 Proto-Oncogene, Polycomb Ring Finger	Pre	11.1
DCTN6	Dynactin Subunit 6	Pre	13.9
TAF13	TATA-Box Binding Protein Associated Factor 13	Pre	11.1
JMY	Junction Mediating And Regulatory Protein, P53	Pre	36.1
ARHGAP5	Rho GTPase Activating Protein 5	Pre	15.3
DENND6A	DENN Domain Containing 6A	Pre	11.1
DBF4	DBF4 Zinc Finger	Pre	15.3
SZT2	Seizure Threshold 2 Homolog (Mouse)	Pre	11.1

Pre-vaccination and tetramer-positive CD4⁺ T cells post-vaccination for Patients 1 and 4

Patient 1		Patient 4		
% cells expressing (Post)	Adjusted P-value	Group in which gene is upregulated	% cells expressing (Pre)	% cells expressing (Post)
76.8	3.00E-08	Pre	54.2	23.1
33.3	5.80E-07	Post	8.5	29.7
20.3	6.60E-06	Post	3.4	22
23.2	0.00014	Post	1.7	19.8
23.2	0.00036	Post	8.5	22
98.6	0.00049	Post	100	100
20.3	0.00067	Post	6.8	17.6
15.9	0.00067	Post	8.5	28.6
15.9	0.00069	Post	1.7	8.8
24.6	0.00075	Post	0	30.8
14.5	0.0014	Post	3.4	15.4
26.1	0.0014	Post	6.8	12.1
20.3	0.0014	Pre	16.9	3.3
15.9	0.0014	Post	1.7	11
15.9	0.0014	Post	5.1	12.1
26.1	0.0015	Post	0	20.9
27.5	0.0015	Post	11.9	20.9
14.5	0.0016	Post	6.8	11
14.5	0.0024	Pre	15.3	1.1
100	0.0025	Post	93.2	100
20.3	0.003	Post	0	11
26.1	0.0032	Post	1.7	18.7
18.8	0.0032	Post	3.4	8.8
18.8	0.0033	Post	6.8	8.8
21.7	0.0034	Post	1.7	16.5
24.6	0.0034	Post	8.5	24.2
15.9	0.0035	Post	5.1	14.3
24.6	0.0036	Post	1.7	11
20.3	0.0037	Pre	16.9	4.4
97.1	0.0041	Post	74.6	95.6
97.1	0.0046	Post	88.1	100
21.7	0.0047	Post	5.1	11
13	0.0052	Post	3.4	14.3
11.6	0.0052	Post	0	13.2
18.8	0.0054	Post	5.1	28.6
17.4	0.0055	Post	5.1	15.4
14.5	0.0056	Post	5.1	15.4
15.9	0.0059	Post	5.1	12.1
17.4	0.006	Post	6.8	12.1
15.9	0.0061	Pre	16.9	5.5

21.7	0.0063	Post	6.8	17.6
95.7	0.0063	Post	79.7	96.7
20.3	0.0065	Post	5.1	23.1
15.9	0.0069	Post	5.1	11
17.4	0.0073	Post	3.4	14.3
97.1	0.0075	Post	94.9	98.9
15.9	0.0076	Post	0	13.2
11.6	0.0077	Post	5.1	16.5
20.3	0.008	Post	5.1	14.3
14.5	0.0082	Post	6.8	14.3
15.9	0.0083	Post	5.1	15.4
81.2	0.0088	Post	57.6	74.7
11.6	0.0091	Post	3.4	9.9
15.9	0.0095	Post	1.7	11
88.4	0.0096	Post	59.3	85.7
100	0.0097	Post	98.3	100
13	0.01	Post	1.7	45.1
29	0.01	Post	5.1	24.2
17.4	0.011	Post	6.8	14.3
15.9	0.011	Post	6.8	18.7
21.7	0.011	Pre	11.9	6.6
14.5	0.012	Post	3.4	13.2
13	0.012	Post	0	16.5
13	0.013	Post	0	14.3
17.4	0.013	Post	5.1	11
17.4	0.013	Post	5.1	13.2
11.6	0.013	Post	5.1	12.1
21.7	0.013	Post	3.4	12.1
13	0.015	Post	5.1	14.3
11.6	0.015	Post	3.4	16.5
20.3	0.015	Post	3.4	16.5
14.5	0.015	Post	3.4	17.6
23.2	0.017	Post	3.4	19.8
71	0.017	Post	0	11
89.9	0.017	Post	69.5	93.4
13	0.018	Post	6.8	15.4
14.5	0.018	Post	8.5	13.2
15.9	0.018	Post	6.8	19.8
17.4	0.019	Post	0	11
15.9	0.02	Pre	15.3	5.5
17.4	0.02	Post	5.1	14.3
13	0.02	Post	3.4	8.8
21.7	0.02	Post	10.2	18.7
11.6	0.02	Post	5.1	13.2
14.5	0.021	Post	11.9	17.6
11.6	0.021	Post	5.1	16.5
15.9	0.022	Post	5.1	15.4

13	0.023	Post	5.1	9.9
98.6	0.023	Post	98.3	100
14.5	0.023	Post	1.7	9.9
97.1	0.024	Post	76.3	94.5
17.4	0.024	Post	3.4	15.4
21.7	0.024	Post	1.7	19.8
13	0.025	Post	6.8	16.5
17.4	0.025	Pre	18.6	6.6
17.4	0.026	Post	3.4	19.8
13	0.026	Post	3.4	12.1
84.1	0.027	Post	67.8	86.8
11.6	0.027	Post	5.1	16.5
13	0.027	Pre	13.6	5.5
13	0.028	Post	3.4	20.9
71	0.028	Post	49.2	72.5
11.6	0.029	Post	10.2	14.3
14.5	0.03	Post	1.7	13.2
17.4	0.031	Post	1.7	18.7
10.1	0.032	Post	1.7	18.7
13	0.032	Post	5.1	14.3
11.6	0.033	Post	3.4	8.8
13	0.034	Post	3.4	9.9
20.3	0.035	Post	5.1	16.5
20.3	0.036	Post	6.8	14.3
14.5	0.037	Post	5.1	14.3
13	0.037	Post	5.1	13.2
13	0.037	Pre	15.3	7.7
14.5	0.037	Post	6.8	13.2
17.4	0.041	Post	0	11
20.3	0.042	Post	3.4	15.4
11.6	0.042	Post	3.4	12.1
85.5	0.042	Post	71.2	86.8
11.6	0.042	Post	5.1	15.4
23.2	0.048	Post	5.1	37.4
17.4	0.048	Post	6.8	22
14.5	0.051	Post	3.4	12.1
14.5	0.051	Post	3.4	13.2
13	0.052	Post	3.4	8.8
20.3	0.052	Post	6.8	15.4
14.5	0.052	Post	3.4	9.9
14.5	0.053	Post	3.4	15.4
26.1	0.053	Post	5.1	11
10.1	0.054	Pre	11.9	4.4
14.5	0.055	Pre	10.2	2.2
15.9	0.056	Post	5.1	14.3
13	0.056	Post	10.2	30.8
13	0.056	Post	1.7	14.3

13	0.058	Post	1.7	18.7
13	0.059	Post	3.4	11
15.9	0.059	Post	3.4	9.9
14.5	0.06	Post	3.4	14.3
23.2	0.062	Post	5.1	18.7
10.1	0.063	Post	3.4	16.5
71	0.064	Post	39	76.9
14.5	0.064	Post	3.4	12.1
14.5	0.065	Post	5.1	17.6
78.3	0.066	Post	40.7	78
13	0.068	Post	5.1	14.3
11.6	0.068	Post	3.4	12.1
21.7	0.068	Post	1.7	11
13	0.069	Post	3.4	14.3
18.8	0.07	Post	3.4	22
11.6	0.07	Post	3.4	11
13	0.072	Pre	13.6	9.9
76.8	0.075	Post	49.2	78
18.8	0.079	Pre	20.3	8.8
14.5	0.081	Post	5.1	15.4
13	0.081	Post	6.8	18.7
59.4	0.081	Post	13.6	71.4
91.3	0.081	Post	69.5	89
13	0.082	Post	5.1	9.9
11.6	0.082	Post	5.1	11
21.7	0.083	Post	5.1	15.4
85.5	0.085	Post	55.9	82.4
21.7	0.085	Post	6.8	15.4
55.1	0.086	Post	20.3	73.6
11.6	0.086	Post	5.1	12.1
18.8	0.088	Post	1.7	11
11.6	0.092	Post	6.8	9.9
17.4	0.094	Post	3.4	18.7
11.6	0.096	Post	0	15.4
79.7	0.097	Post	71.2	90.1
13	0.098	Post	6.8	18.7
76.8	0.098	Post	54.2	93.4
10.1	0.099	Post	1.7	9.9
13	0.099	Post	6.8	13.2
65.2	4.20E-09	Post	83.1	96.7
2.9	0.00035	Post	0	20.9
2.9	0.00083	Pre	22	5.5
36.2	0.0028	Post	16.9	71.4
89.9	0.011	Post	78	86.8
7.2	0.013	Post	5.1	17.6
15.9	0.013	Pre	67.8	18.7
7.2	0.021	Post	5.1	14.3

2.9	0.039	Pre	13.6	8.8
7.2	0.043	Pre	15.3	6.6
7.2	0.044	Post	10.2	26.4
4.3	0.053	Post	1.7	13.2
11.6	0.065	Post	16.9	48.4
10.1	0.065	Pre	27.1	7.7
8.7	0.066	Post	6.8	24.2
5.8	0.067	Post	5.1	27.5
8.7	0.087	Pre	16.9	8.8

Adjusted P-value

0.068
0.076
0.0023
0.0016
0.045
2.30E-05
0.051
0.068
0.085
5.50E-06
0.0012
0.093
0.011
0.031
0.012
3.70E-05
0.043
0.034
0.00024
6.60E-06
0.0022
0.0022
0.018
0.063
0.002
0.051
0.0061
0.087
0.002
9.90E-06
2.00E-06
0.092
0.01
0.0008
0.0059
0.019
0.02
0.03
0.084
0.0048

0.073
0.072
0.052
0.052
0.0096
0.0096
0.00032
0.0082
0.018
0.087
0.04
0.067
0.074
0.009
0.055
0.068
2.00E-06
0.0076
0.064
0.085
0.059
0.021
8.10E-05
0.00053
0.075
0.03
0.03
0.011
0.049
0.043
0.0095
0.051
0.012
0.0042
9.60E-06
0.099
0.091
0.01
0.002
0.017
0.028
0.097
0.088
0.074
0.071
0.006
0.0097

0.088
0.0023
0.016
0.002
0.0034
0.0012
0.096
0.051
0.0016
0.018
0.097
0.018
0.073
0.01
0.032
0.08
0.002
0.0011
0.0015
0.031
0.072
0.016
0.015
0.08
0.048
0.013
0.029
0.048
0.0026
0.0042
0.031
0.068
0.036
0.00096
0.081
0.027
0.0096
0.056
0.048
0.055
0.013
0.055
0.033
0.092
0.038
0.039
0.011

0.0008
0.039
0.05
0.024
0.058
0.0074
0.04
0.091
0.014
0.0059
0.017
0.0095
0.0022
0.013
0.0022
0.067
0.055
0.093
0.007
0.029
0.064
2.00E-06
0.087
0.063
0.076
0.018
0.061
0.051
0.00032
0.01
0.011
0.077
0.006
8.10E-05
0.096
0.085
5.90E-05
0.029
0.029
0.0046
1.70E-05
0.0022
0.001
0.05
0.022
0.0007
0.029

0.077

0.077

0.017

0.0032

0.097

0.076

0.03

0.0022

0.072
