

Supplementary table 2: Whole blood panel

Panel	Antibody	Clone	Fluorochrome	Dilution	Vendor	Catalog no
1. Immune-phenotype panel	CD45RA	HI100	BUV395	1:400	BD	740298
	CD8	RPA-T8	BUV496	1:1000	BD	612942
	CD14	M5E2	BUV563	1:400	BD	741360
	CD95	DX2	BUV615	1:100	BD	752346
	TCRgd	11F2	BUV661	1:400	BD	750019
	CD16	3G8	BUV737	1:1000	BD	612786
	CD4	SK3	BUV805	1:800	BD	612887
	CD71	M-A712	BV421	1:400	BD	562995
	CD20	2H7	BV480	1:400	BD	566132
	CD3	UCHT1	BV570-P	1:200	Biolegend	300436
	CD11c	B-ly6	BV605	1:100	BD	563929
	CD27	L128	BV650	1:100	BD	563228
	CCR6	11A9	BV711	1:100	BD	563923
	HLA-DR	G46-6	BV750	1:800	BD	746912
	CD45RB	MT4 (6B6)	BV786	1:400	BD	744655
	CD57	NK-1	BB515	1:400	BD	565285
	PD1	EH12.1	BB700	1:400	BD	566460
	CD138	MI15	PE	1:100	BD	552026
	CD10	HI10a	PE-CF594	1:400	BD	562396
	CD56	B159	PE-Cy5	1:100	BD	555517
	CD24	ML5	PE-Cy7	1:200	BD	561646
	CD38	HIT2	APC	1:50	BD	555462
CD19	SJ25C1	R718	1:400	BD	566946	
CD21	Bu32	APC/FIRE750	1:400	Biolegend	354920	
BD Brilliant Stain buffer plus					BD	566385
2. CD4/CD8 activation panel	CD45RA	HI100	BUV395	1:600	BD	740298
	CD8	RPA-T8	BUV496	1:1000	BD	612942
	CD27	L128	BUV563	1:400	BD	748705
	CD38	HIT2	BUV615	1:200	BD	751138
	CD137	4B4-1	BUV661	1:200	BD	741642
	CD40-L	TRAP1	BUV737	1:200	BD	748983
	CD4	SK3	BUV805	1:800	BD	612887
	CD127	HIL-7R-M21	BV421	1:200	BD	562436
	CD15S	CSLEX1	BV510	1:800	BD	563529
	CD3	UCHT1	BV570-P	1:200	Biolegend	300436
	CCR7	2-L1-A	BV605	1:100	BD	566754
	TIGIT	741182	BV650	1:400	BD	747840
	CXCR3	1C6/CXCR3	BV711	1:200	BD	563156
	HLA-DR	G46-6	BV750	1:800	BD	746912
	TIM-3	7D3	BV786	1:200	BD	742857
	CCR6	11A9	BB515	1:100	BD	564479
	PD1	EH12.1	BB700	1:400	BD	566460
	ICOS	DX29	PE	1:100	BD	557802
	CCR4	1G1	PE-CF594	1:400	BD	565391
	CTLA-4	BNI3	PE-Cy5	1:400	BD	555854
	CD25	M-A251	PE-Cy7	1:400	BD	557741
	CXCR5	RF8B2	APC-R700	1:200	BD	565191
CD226	11A8	APC/FIRE750	1:100	Biolegend	338320	
Brilliant Stain buffer plus					BD	566385

Supplementary table 3: Whole blood population annotations

Population	Panel	Defining markers
B cells	1	CD19+
Naive		CD27-CD38-
Transitional		CD38+CD10+
Plasmablast		CD20-CD27+CD38+CD138-
Plasma cell		CD20-CD27+CD38+CD138+
Memory		CD27dimCD38-
Atypical		CD11c+/-CD27-CD21dim/-
CD4 T cells	1 and 2	CD3+CD4+
Central memory		CD45RA-CD27+
Effector memory		CD45RA-CD27-
Effector memory CD45RA+		CD45RA+CD27-
Stem cell memory		CD45RA+CD27+CD95+
Naive		CD45RA+CD27+CD95-
CD8 T cells	1 and 2	CD3+CD8+
Central memory		CD45RA-CD27+
Effector memory		CD45RA-CD27-
Effector memory CD45RA+		CD45RA+CD27-
Stem cell memory		CD45RA+CD27+CD95+
Naive		CD45RA+CD27+CD95-
Memory Th cells	2	CD3+CD4+CD45RA-CXCR5-
Th1		CXCR3+CCR6-CCR4-
Th1-like		CXCR3+CCR6+CCR4-
Th2		CXCR3-CCR6-CCR4+
CXCR3+ Th2		CXCR3+CCR6-CCR4+
Th9		CXCR3-CCR6+CCR4-
Th17		CXCR3-CCR6+CCR4+
CXCR3+ Th17		CXCR3+CCR6+CCR4+
Th Triple Negative		CXCR3-CCR6-CCR4-
T regulatory		CD127-CD25+
T follicular helper cells	2	CD3+CD4+CXCR5+
Tfh1		CXCR3+CCR6-CCR4-
Tfh1-like		CXCR3+CCR6+CCR4-
Tfh2		CXCR3-CCR6-CCR4+
CXCR3+ Tfh2		CXCR3+CCR6-CCR4+
Tfh9		CXCR3-CCR6+CCR4-
Tfh17		CXCR3-CCR6+CCR4+
CXCR3+ Tfh17		CXCR3+CCR6+CCR4+
Tfh Triple Negative		CXCR3-CCR6-CCR4-
Tf regulatory		CD127-CD25+

Supplementary table 4: Panel design antigen probes

Protein antigen	Fluorochrome-conjugated streptavidin	Concentration	Source	Catalog No
Wuhan SARS-CoV-2 Spike	Alexa Fluor® 647	0.5 ug/ul	BioLegend	405237
	Brilliant Violet™ 421	0.5 ug/ul		405225
Wuhan SARS-CoV-2 RBD	PE-Alexa Fluor® 610	1 ug/ul	Invitrogen	S20982
H1N1 HA	BUV615	0.1 ug/ul	BD	613013
	Brilliant Violet™ 421	0.5 ug/ul	BioLegend	405225
Nucleocapsid	Brilliant Blue™ 515	0.1 ug/ul	BD	564453
	Alexa Fluor® 647	0.5 ug/ul	BioLegend	405237
RSV F	BUV615	0.1 mg/mL	BD	613013
	Alexa Fluor® 647	0.5 ug/ul	BioLegend	405237
Tetanus toxoid	Brilliant Blue™ 515	0.1 ug/ul	BD	564453
	Brilliant Violet™ 421	0.5 ug/ul	BioLegend	405225

Supplementary table 5: Spike specific B cell panel

Antibody	Clone	Fluochrome	Dilution	Vendor	Catalog no
CD24	ML5	BUV395	1/80	BD	563818
Viability	-	Live/Dead Blue	1/1000	Thermofisher	L23105
HLA-DR	G46-6	BUV496	1/80	BD	749866
IgD	IA6-2	BUV563	1/160	BD	741394
<i>Antigen probe</i>		BUV615		BD	613013
CD126	M5	BUV661	1/20	BD	752527
CD138	MI15	BUV737	1/100	BD	612834
CD21	B-ly4	BUV805	1/160	BD	742008
<i>Antigen probe</i>		BV421		Biolegend	405225
CD20	2H7	cFluor V450	1/40	Cytek	SKU R7-20015
CD27	L128	BV480	1/20	BD	566188
CD3 (DUMP)	UCHT1	BV510	1/50	Biolegend	300448
CD4 (DUMP)	OKT4	BV510	1/50	Biolegend	317444
CD16 (DUMP)	3G8	BV510	1/50	Biolegend	302048
CD56 (DUMP)	HCD56	BV510	1/50	Biolegend	318340
CD19	HIB19	BV570	1/40	Biolegend	302236
CD11c	B-ly6	BV605	1/160	BD	563929
CXCR5	RF8B2	BV650	1/20	BD	740528
IgM	MHM-88	BV711	1/80	Biolegend	314540
CD71	M-A712	BV750	1/80	BD	747308
FcRL5	509F6	BV785	1/100	BD	749602
<i>Antigen probe</i>		BB515		BD	564453
CD73	AD2	cFluor B532	1/80	Cytek	SKU R7-20017
CXCR3	1C6	BB700	1/25	BD	566532
CXCR4	12G5	PerCP-eFluor710	1/50	Thermo Fisher	46-9999-42
CD45RB	MEM-55	PE	1/80	Biolegend	310204
IgG	G18-145	PE-CF594	1/160	BD	562538
<i>Antigen probe</i>		PE-alexa fluor 610		Invitrogen	S20982
CD95	DX2	PE-Cy5	1/320	Biolegend	305610
CD30	BY88	PE-Cy7	1/12	Biolegend	333918
CD269	19F2	APC	1/25	Biolegend	357506
<i>Antigen probe</i>		AF647		Biolegend	405237
CD86	2331 (FUN-1)	APC-R700	1/320	BD	565149
IgA	IS11-8E10	APC-Vio770	1/320	Miltenyi Biotec	130-113-473
CD38	HIT2	APC-Fire810	1/160	Biolegend	303550

Supplementary table 6: Antigen-specific B cell cluster annotations

Cluster	B cell population	Ig isotype	Defining markers	Additional markers
1	IgM+ MBC	IgM	CD19+ CD20+ CD27+ CD38-	CD21+ CD24+ CD45RB+
2	CD45RB+ naïve B cell	IgD/IgM	CD19+ CD20+ CD27- CD38-	CD21+ CD24+ CD45RB+
3	Naïve B cell	IgD	CD19+ CD20+ CD27- CD38-	CD21+ CD73+
4	Transitional B cell	IgD/IgM	CD19+ CD20+ CD27- CD38lo	CD21+ CD24+
5	IgA+ MBC	IgA	CD19+ CD20+ CD27+ CD38-	CD21+ CD24+/- CD73+/- CD45RB+/-
6	IgD/IgM+ MBC	IgD/IgM	CD19+ CD20+ CD27+ CD38-	CD24+ CD95+
7	IgD/IgM+ ActBC	IgD/IgM	CD19+ CD20+ CD27- CD38lo	CD21- CD71+/- CD11c+/- CD24+/-
8	IgG+ MBC	IgG	CD19+ CD20+ CD27+ CD38-	CD21+/- CD24+ CD73+/- CD45RB+/-
9	Undefined	-	-	-
10	IgG+ ASC	IgG	CD19lo CD20lo CD27hi CD38hi CD138+/-	CD21- CD71hi CD24- CD45RB+/-
11	IgA+ ASC	IgA	CD19lo CD20lo CD27hi CD38hi CD138+/-	CD21- CD71hi CD24- CD45RB+/-
12	IgM+ ASC	IgM	CD19lo CD20lo CD27hi CD38hi CD138+/-	CD21- CD71hi CD24- CD45RB+
13	IgA+ ActBC	IgA	CD19+ CD20+ CD27+ CD38- CD71hi	CD21- CD24+/- CD95+ CD45RB+/- CD11c+/-
14	IgA+ DN2	IgA	CD19+ CD20+ CD27- CD38- CD11c hi	CD21- CD71- CD24- CD95+
15	IgG+ DN3	IgG	CD19lo CD20lo CD27- CD38-	CD21- CD71- CD24-
16	IgG+ DN2	IgG	CD19+ CD20+ CD27- CD38- CD11c hi	CD21- CD71- CD24+/- CD95+
17	IgG+ ActBC	IgG	CD19+ CD20+ CD27+ CD38- CD71hi	CD21- CD24+/- CD95+ CD45RB+/- CD11c+/-

Abbreviations: DN = double negative B cell; MBC = memory B cell; ASC = antibody secreting cell; ActBC = activated B cell; +/- = expression present in part of the cluster

Supplementary table 7: AIM CD4 T cell panel

Antibody	Clone	Fluochrome	Dilution	Intra- or extracellular staining	Vendor	Catalog no
CD4	SK3	BUV395	1:50	intracellular	BD	563550
CD8	RPA-T8	BUV496	1:50	intracellular	BD	612942
CD27	L128	BUV563	1:400	extracellular	BD	748705
CD14	M5E2	BUV615	1:100	extracellular	BD	751150
ICOS (CD278)	DX29	BUV661	1:25	extracellular	BD	741664
CD69	FN50	BUV737	1:100	intracellular	BD	612817
CD3	SK7	BUV805	1:200	intracellular	BD	612893
CD40L (CD154)	24-31	BV421	1:100	intracellular	Biolegend	310824
IFN γ	B27	BV480	1:50	intracellular	BD	566100
Viability dye		FVS575V	1:400	extracellular	BD	565694
CCR4 (CD194)	1G1	BV605	1:50	extracellular	BD	562906
TNF	Mab11	BV650	1:400	intracellular	BD	563418
CXCR5 (CD185)	RF8B2 / J2522D4	BV711 / PE-Dazzle*	1:400 / 1:100	extracellular	BD / Biolegend	740737 / 356927
CD38	HIT2	BV750	1:50	extracellular	BD	746909
CD45RA	HI100	BV786	1:400	extracellular	BD	563870
CCR6 (CD196)	11A9	BB515	1:25	extracellular	BD	564479
PD1	EH12.1	BB700	1:100	extracellular	BD	566460
IL2	MQ1-17H12	PE	1:200	intracellular	Biolegend	500307
CD137 (4-1BB)	4B4-1	PE-Cy5	1:200	intracellular	BD	551137
CXCR3 (CD183)	1C6	PE-Cy7	1:25	extracellular	BD	560831
IL21	3A3-N2.1	AF647	1:50	intracellular	BD	560493
IL17A	N49-653	APC-R700	1:3200	intracellular	BD	565163
HLA-DR	G46-6	APC-H7	1:400	extracellular	BD	561358
Brilliant Stain buffer plus					BD	566385

* Either CXCR5:BV711 or CXCR5:PE-Dazzle was used in the panel