

eFigure Legends:

eFigure 1. Whole blood immune profiling gating strategy.

eFigure 2. Immunophenotyping of B cell subsets within PBMC. (A) Representative gating strategy for immunophenotyping B-cell subsets. **(B)** Quality confirmation of cryopreserved PBMC. Viabilities after cryopreservation and thaw, assessed as percent-live cells using Aqua Live/Dead staining and flow cytometry. Similarly, high viabilities were confirmed for samples of patients with PD ($89.8\% \pm 4.38$; $n = 30$) and NC ($90.0\% \pm 3.96$; $n = 35$). **ns:** not significant.

eFigure 3. Illustration of differentiation stages of human B-cell subsets identifying stage-associated markers.

eFigure 4. Gating Strategy for flow cytometry analysis on T cell and innate immune cell subsets.

figure 1. Whole blood immune profiling gating strategy.

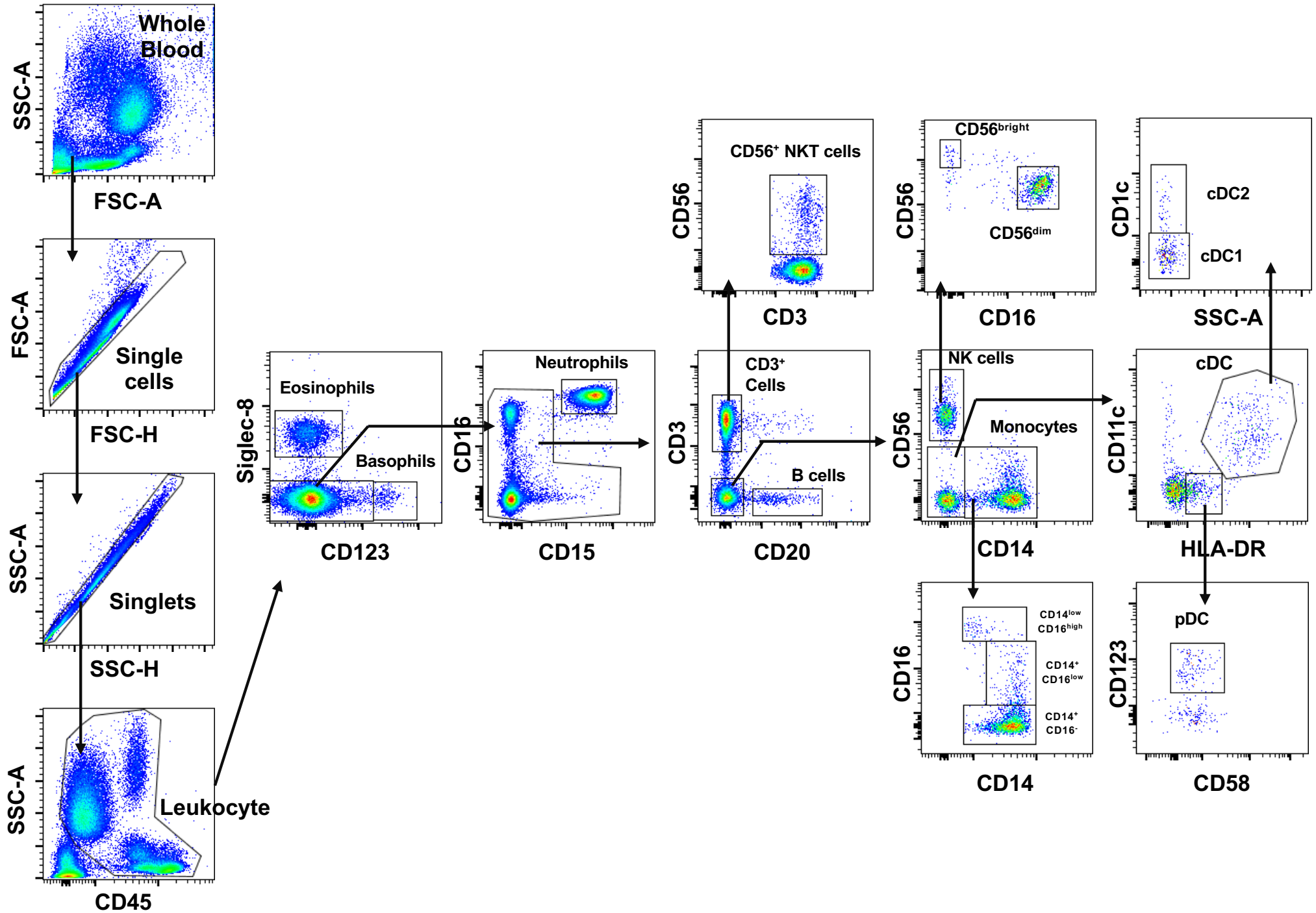
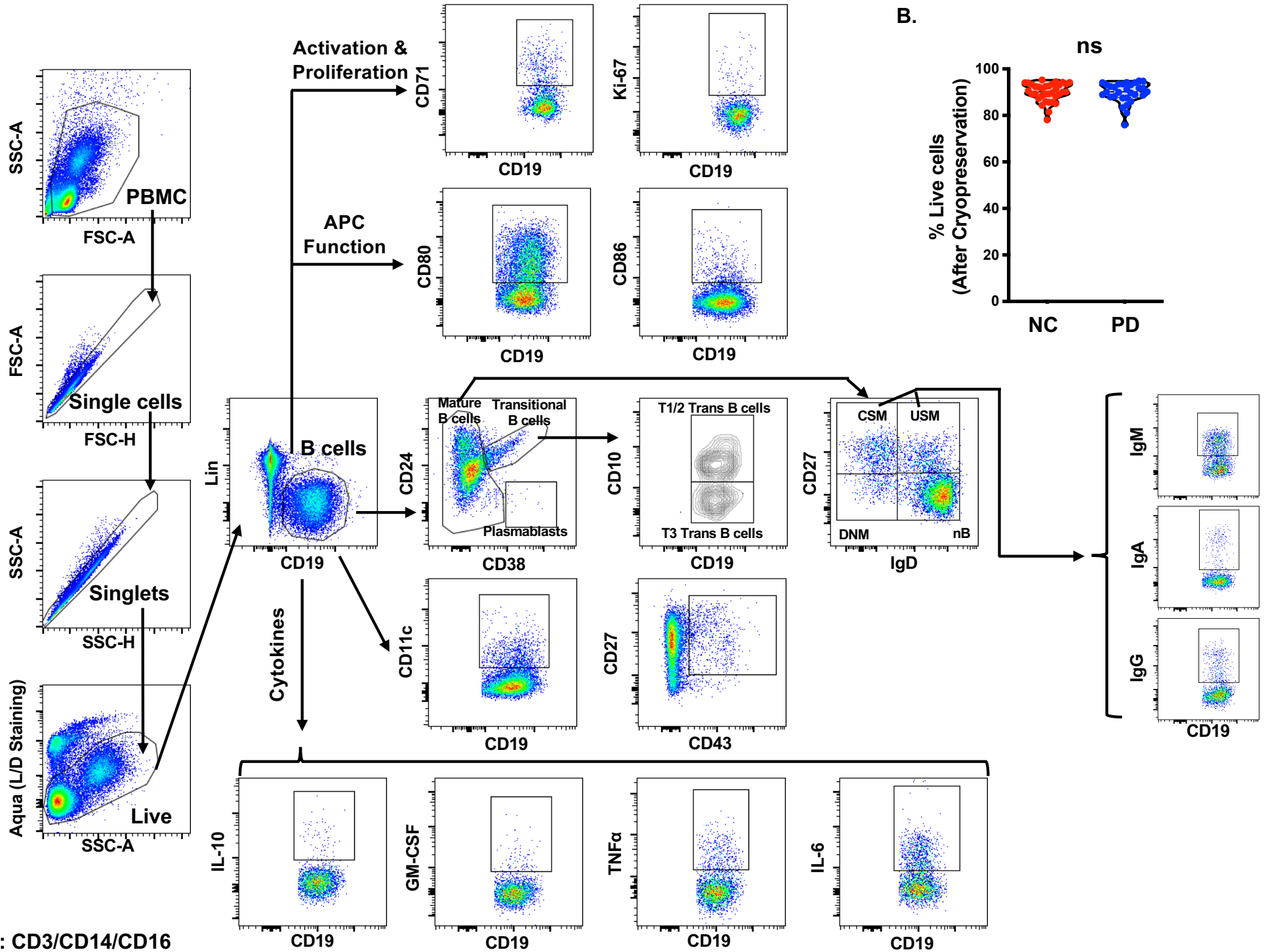


figure 2. Immunophenotyping of B cell subsets within PBMC.

A.



efigure 3. Illustration of differentiation stages of human B-cell subsets identifying stage-associated markers.

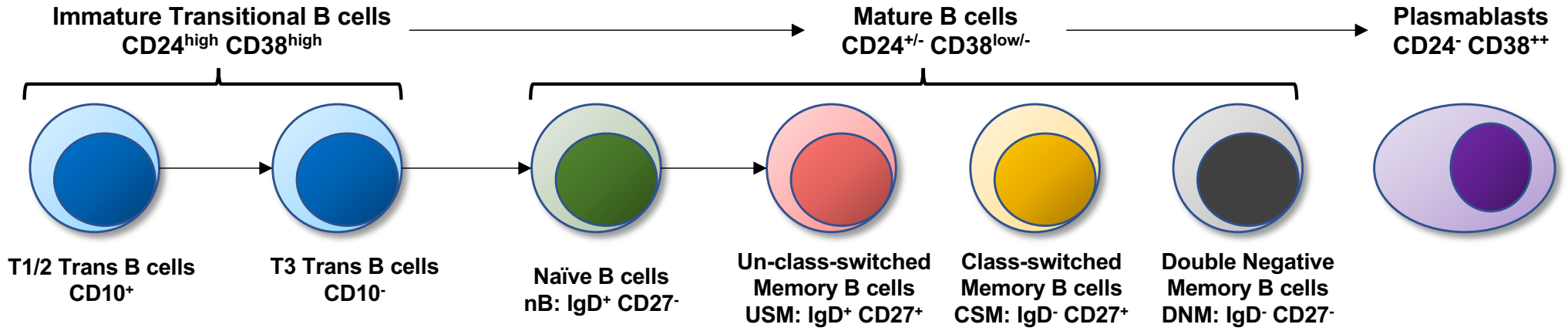
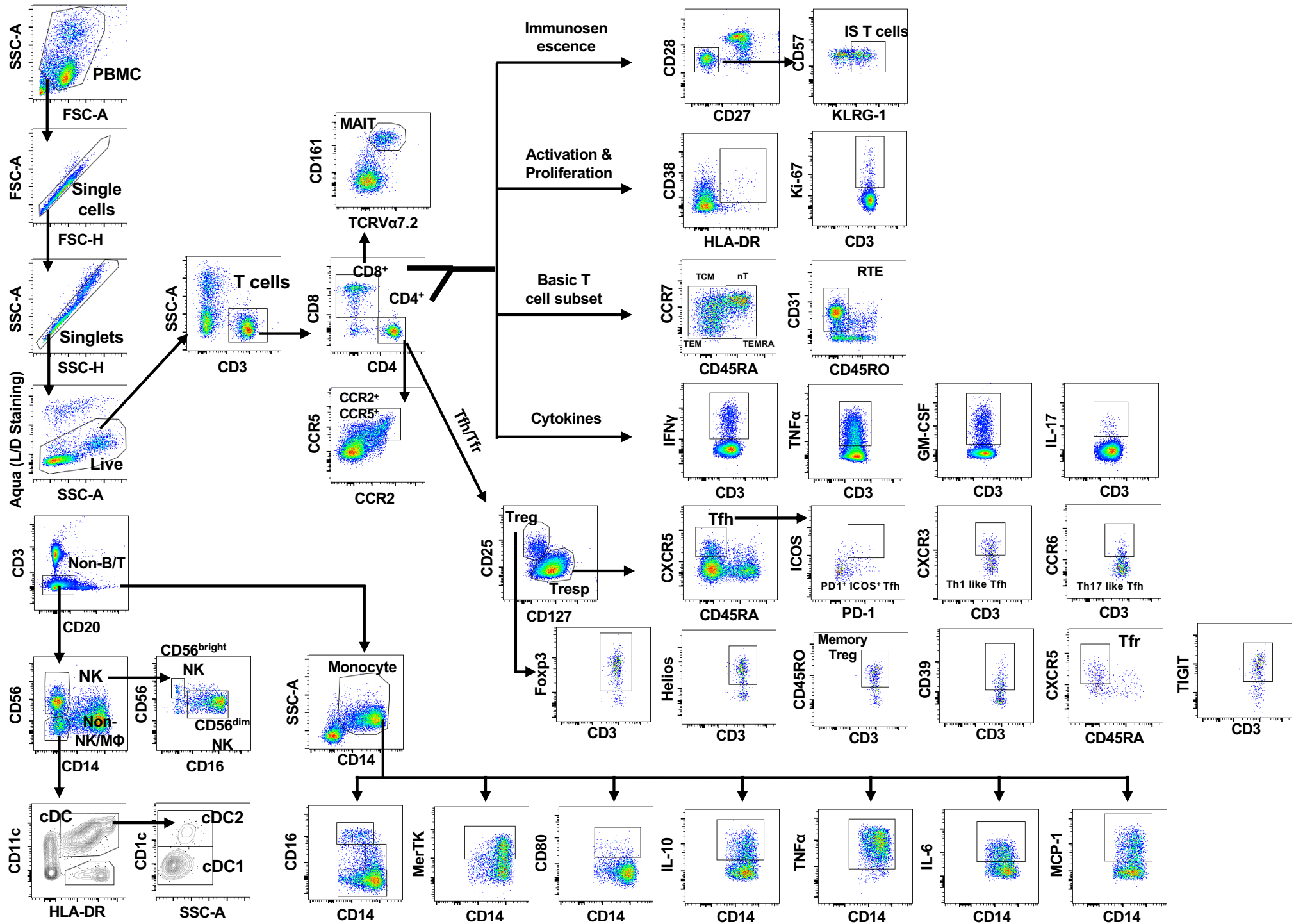


figure 4. Gating Strategy for immunophenotyping non-B cell populations (T cell, Monocyte and NK cell)



eTable 1. Overview of participant cohorts

	Whole Blood Immunophenotyping				Cryopreserved PBMC			
	Discovery Cohort*		Validation Cohort**		Discovery Cohort		Validation Cohort	
Groups	NC	PD	NC	PD	NC	PD	NC	PD
Number	7	13	8	21	17	12	18	18
Gender (F/M)	1/6	1/12	7/1	5/16	6/11	1/11	5/13	5/13
Age (Mean ± SD)	71.4±4.6	73.5±6.2	67.0±8.7	66.0±11.1	67.8±6.2	73.7±6.4	61.1±11.6	64.3±10.6

*Patients from the Discovery Cohort were recruited from University of Pennsylvania.

**Patients from the Validation Cohort were recruited from Columbia University.

PBMC: Peripheral Blood Mononuclear Cells

NC: Normal Control

PD: Parkinson's Disease

SD: Standard Deviation

eTable 2. Participant Demographics

Cohort	Study ID	Group	Age	Sex	Disease Duration (years)	LEDD	Comorbidities
Discovery Cohort	UP-006	NC	69	F	—	—	Hypertension
	UP-012	NC	75	M	—	—	Osteoarthritis, Hypertension
	UP-014	NC	74	M	—	—	Osteoarthritis
	UP-017	NC	66	M	—	—	Ulcerative Colitis, Anemia, Hypertension
	UP-018	NC	66	M	—	—	No comorbidities
	UP-019	NC	78	M	—	—	Lumbar Stenosis
	UP-020	NC	72	M	—	—	Osteoarthritis, Hypertension, Atrial fibrillation
	UP-022	NC	62	F	—	—	Hypertension, Hypothyroid
	UP-023	NC	63	M	—	—	Osteoarthritis, Anemia
	UP-026	NC	72	M	—	—	Asthma, Hypothyroid, IGA deficiency
	UP-028	NC	61	F	—	—	Hiatal Hernia
	UP-029	NC	63	F	—	—	Hypertension
	UP-032	NC	69	M	—	—	Gauchers Disease, Anemia, Hypertension
	UP-033	NC	77	F	—	—	No comorbidities
	UP-035	NC	57	F	—	—	Coronary Artery Disease, Hypertension
	UP-037	NC	68	M	—	—	No comorbidities
	UP-040	NC	60	M	—	—	No comorbidities
	UP-001	PD	75	M	14	1397	Hypertension, Osteoarthritis, Coronary artery disease, Diabetes
	UP-004	PD	70	M	16	1540	Dementia
	UP-007	PD	65	F	10	DBS	Osteoarthritis
	UP-011	PD	79	M	10	1771	Melanoma, Hypertension, Benign prostatic hyperplasia, Mitral valve prolapse
	UP-013	PD	81	M	15	350	Skin cancers, Hyperthyroid
	UP-015	PD	76	M	20	1348	Hypertension, Atrial fibrillation
	UP-002	PD	75	M	9	1100	Hypertension, Hypothyroid
	UP-003	PD	82	M	13	2033	Atrial Fibrillation, Barrett's esophagus
	UP-005	PD	66	M	19	200	Blepharospasm, Hypertension, Congestive heart failure
	UP-008	PD	81	M	5	300	Hypertension
	UP-009	PD	68	M	N/A	700	Hypertension
	UP-016	PD	66	M	N/A	1300	No comorbidities
	UP-010	PD	71	M	15	1287	No comorbidities

eTable 2. Participant Demographics (Continue)

Cohort	Study ID	Group	Age	Sex	Disease Duration (years)	LEDD	Comorbidities
Validation Cohort	CU-004	NC	84	M	—	—	Hearing Loss, Gall Bladder Removed (benign polyps)
	CU-009	NC	59	F	—	—	Hypertension
	CU-011	NC	73	F	—	—	Arrythmia
	CU-014	NC	63	F	—	—	No comorbidities
	CU-016	NC	71	F	—	—	Arthritis, COPD, Benign kidney tumoer
	CU-024	NC	65	F	—	—	Hypertension, Peptic ulcer disease
	CU-025	NC	57	F	—	—	Skin cancer
	CU-029	NC	68	F	—	—	Hypothyroidism; GERD
	UP-030	NC	68	M	—	—	Hypertension
	UP-031	NC	73	M	—	—	No comorbidities
	UP-036	NC	61	M	—	—	No comorbidities
	UP-038	NC	65	M	—	—	No comorbidities
	UP-039	NC	62	M	—	—	Hypertension, migraine, Hypothyroid
	UP-043	NC	41	M	—	—	No comorbidities
	UP-044	NC	54	M	—	—	No comorbidities
	UP-046	NC	72	M	—	—	No comorbidities
	UP-048	NC	42	M	—	—	No comorbidities
	UP-050	NC	57	M	—	—	No comorbidities
	UP-052	NC	43	M	—	—	No comorbidities
	UP-054	NC	55	M	—	—	No comorbidities
	CU-002	PD	67	M	16	1000	Sciatica
	CU-006	PD	57	F	8	700	Anemia
	CU-008	PD	63	M	9	300	No comorbidities
	CU-013	PD	67	M	5	100	Skin cancer
	CU-015	PD	83	M	4	350	Prostate cancer
	CU-018	PD	70	M	18	1500	No comorbidities
	CU-026	PD	65	M	4	150	Hypertension
	CU-027	PD	72	M	13	750	Arrythmia
	CU-028	PD	73	F	14	475	Hypertension
	CU-001	PD	76	M	10	0	No comorbidities
	CU-007	PD	50	M	3	100	No comorbidities
	CU-010	PD	76	M	4	100	Hypertension, Arrythmia, Brain tumor - stable and COPD
	CU-012	PD	62	F	7	100	Gaucher Disease
	CU-019	PD	60	F	23	400	No comorbidities
	CU-020	PD	48	F	1	50	Mild athritis
CU-021	PD	58	M	11	375	Gaucher Disease	
CU-022	PD	42	M	3	0	Multiple Sclerosis	
CU-023	PD	68	M	13	900	Microsmia	
CU-003	PD	82	M	7	400	No comorbidities	
CU-005	PD	73	M	11	400	No comorbidities	
CU-017	PD	79	M	21	600	No comorbidities	

IP: Immunophenotyping; LEDD: Levodopa Equivalent Daily Doses; NC: Normal Control; PD: Parkinson's Disease
 DBS: Deep Brain Stimulation; N/A: not available; —: Not applicable.

eTable 3. List of Antibodies used in the study

Marker	Fluorochrome	Vender	Clone	Catalogue #	ul/test
Helios	Alexa Fluor 488	Biolegend	22F6	137223	5
CD278 (ICOS)	FITC	Biolegend	C398.4A	313506	2
CD14 (Lin)	FITC	BD Biosciences	M5E2	555397	5
CD14	FITC	BD Biosciences	MøP9	347493	5
CD16 (Lin)	FITC	BD Biosciences	NKP15	347523	5
CD3	FITC	BD Biosciences	UCHT1	555332	5
CD45RA	FITC	BD Biosciences	HI100	555488	5
TCR Valpha 7.2	FITC	Miltenyi Biotec	REA179	130-100-189	2
IgD	BB700	BD Biosciences	IA6-2	566538	5
IL-8	PerCP	Biolegend	BH0814	514606	4
CD141 (BDCA-3)	PerCP-Cy5.5	Biolegend	M80	344112	4
CD3	PerCP-Cy5.5	Biolegend	SK7	344808	5
CD57	PerCP-Cy5.5	Biolegend	QA17A04	393312	4
TIGIT	PerCP-eFluor710	ThermoFisher	MBSA43	46-9500-42	3
CD197 (CCR7)	Alexa Fluor 647	BD Biosciences	150503	560816	5
CD1c	Alexa Fluor 647	BD Biosciences	F10/21A3	565048	3
TNFa	APC	BD Biosciences	Mab11	554514	1
IgA	APC	Miltenyi Biotec	IS11-8E10	130-113-472	1.5
CD21	APC	BD Biosciences	B-ly4	559867	4
MerTK	APC	Biolegend	590H11G1E3	367606	5
CD71	APC	ThermoFisher	OKT9	17-0719-42	5
CD86	APC	BD Biosciences	2331 (FUN-1)	565149	4
CD39	APC	Biolegend	A1	328210	5
CD196 (CCR6)	APC	BD Biosciences	11A9	560619	4
Tim-1	Alexa Flour 700	R&D Systems	219211	FAB1750N	1
IgM	Alexa Fluor 700	Biolegend	MHM-88	314538	4
CD8	APC-R700	BD Biosciences	RPA-T8	565165	2
TNFa	APC-Cy7	Biolegend	Mab11	502944	4
CD16	APC-Cy7	BD Biosciences	3G8	557758	3
CD95	APC-Fire750	Biolegend	DX2	305638	3
CD19	APC-Fire750	Biolegend	SJ25C1	363030	5
CD45RO	APC-H7	BD Biosciences	UCHL1	561137	4
CD192 (CCR2)	BV421	Biolegend	K036C2	357210	4
CD49d	BV421	Biolegend	9F10	304322	3
CD25	BV421	BD Biosciences	2A3	564033	5

eTable 3. List of Antibodies used in the study (Continue)

Marker	Fluorochrome	Vender	Clone	Catalogue #	ul/test
CD28	BV421	BD Biosciences	CD28.2	562613	3
CD43	BV421	BD Biosciences	1G10	562916	5
TIGIT	BV421	BD Biosciences	741182	747844	2
CD123 (IL-3R)	BV421	BD Biosciences	7G3	563362	2
GM-CSF	BV421	BD Biosciences	BVD2-21C11	562930	5
IL-6	BV421	BD Biosciences	MQ2-13A5	563279	3
CD45	BV480	BD Biosciences	HI30	566115	4
Live/Dead	Aqua	ThermoFisher	Not applicable	L34966	0.5
CD279 (PD-1)	BV650	BD Biosciences	NAT105	752738	3
CD56	BV650	Biologend	HCD56	318344	2
CD27	BV650	BD Biosciences	M-T271	564894	5
IL-17A	BV650	BD Biosciences	N49-653	563746	4
CD15	BV650	BD Biosciences	HI98	564232	5
Ki-67	BV650	BD Biosciences	B56	563757	4
CD56	BV650	BD Biosciences	NCAM-16.2	564057	4
CD4	BV711	BD Biosciences	SK3	563028	5
CD24	BV711	BD Biosciences	ML5	563401	5
CD3	BV711	BD Biosciences	UCHT1	563725	2
TNFa	BV785	Biologend	Mab11	502948	3
CD62L (L-selectin)	BV785	Biologend	SK11	304830	5
CD45RA	BV786	BD Biosciences	HI100	563870	2
HLA-DR	BV786	BD Biosciences	G46-6	564041	3
GM-CSF	PE	BD Biosciences	BVD2-21C11	554507	0.5
CD127	PE	BD Biosciences	HIL-7R-M21	557938	1
IL-6	PE	BD Biosciences	MQ2-13A5	554545	0.25
CD152 (CTLA-4)	PE	Biologend	BNI3	369604	5
Ki-67	PE	Miltenyi Biotec	REA183	130-100-289	1.5
Siglec-8	PE	Miltenyi Biotec	7C9	130-098-725	5
CD80	PE	BD Biosciences	L307.4	557227	10
MCP-1 (CCL2)	PE	BD Biosciences	5D3-F7	559324	5
CD10	PE-CF594	BD Biosciences	HI10a	562396	4
CD195 (CCR5)	PE-CF594	BD Biosciences	2D7/CCR5	562456	4
IL-10	PE-CF594	BD Biosciences	JES3-19F1	562400	5
CD56	PE-CF594	BD Biosciences	NCAM-16.2	564849	3
IL-4	PE-CF594	BD Biosciences	MP4-25D2	565161	5

eTable 3. List of Antibodies used in the study (Continue)

Marker	Fluorochrome	Vender	Clone	Catalogue #	ul/test
CD185 (CXCR5)	PE-Dazzle 594	Biolegend	J252D4	356928	2
CD1c (BDCA-1)	PE-Dazzle 594	Biolegend	L161	331532	5
KLRG-1	PE-Dazzle 594	Biolegend	SA231A2	367710	3
FOXP3	PE-eF610	ThermoFisher	PCH101	61-4776-42	4
CD357 (GITR)	PE-Vio615	Miltenyi Biotec	REA1007	130-116-842	2
CD127	PE-Cy7	Beckman Coulter	R34.34	A64618	4
CD11c	PE-Cy7	BD Biosciences	B-ly6	561356	5
CD83	PE-Cy7	BD Biosciences	HB15e	561132	3
IgG	PE-Cy7	BD Biosciences	G18-145	561298	4
MIP-1a (CCL3)	PE-Vio770	Miltenyi Biotec	REA257	130-103-631	2
CD161	PE-Vio770	Miltenyi Biotec	REA631	130-113-597	1
CD38	BUV395	BD Biosciences	HB7	563811	5
CD31	BUV395	BD Biosciences	WM59	565290	1
CD58	BUV395	BD Biosciences	1C3	565460	5
IFN-γ	BUV395	BD Biosciences	B27	563563	2
CD20	BUV805	BD Biosciences	2H7	612905	5
CD4	BUV805	BD Biosciences	SK3	612887	3

eTable 4. Flow cytometry staining panels for Immunophenotyping

Fluorochrome	IP Panel for Whole Blood	Immunophenotyping Panels of Peripheral Blood Mononuclear Cells								
		Classic B	Cyto/Ig B	Act B	Basic T	Effector T	Tfh	Treg & RTE	Innate	MΦ Cyto
FITC	CD14	Lin	Lin	Lin	CD45RA	TCRVα7.2	ICOS	Helios	CD14	CD14
PerCp Cy5.5	CD3	IgD	IgD	IgD	CD57		CD57	TIGIT		IL-8
APC	CD1c	CD21	IgA	CD71	CCR7	CCR6	CCR6	CD39	MerTK	TNFα
APC-R700	CD8	CD86	IgM	Tim-1	CD8	CD8	CD8	CD8	CD86	
APC-Cy7	CD16	CD19	CD19	CD19	CD95	TNFα		CD45RO	CD16	CD16
BV421	CD123	CD43	GM-CSF	TIGIT	CD28	CCR2	CD25	CD25	CD123	IL-6
BV450	CD45	Aqua	Aqua	Aqua	Aqua	Aqua	Aqua	Aqua	Aqua	Aqua
BV650	CD15	CD27	CD27	CD27	CD27	IL-17	PD-1	Ki-67	CD56	CD56
BV711	CD4	CD24	CD24	CD24	CD3	CD3	CD3	CD3	CD3	CD3
BV786	HLA-DR	HLA-DR	TNFα	CD62L	HLA-DR	CD45RA	CD45RA	HLA-DR	HLA-DR	
PE	Siglec-8	CD80	IL-6	Ki-67	Ki-67	GM-CSF	CXCR3		CD80	MCP-1
PE-CF594	CD56	CD10	IL-10	GITR	KLRG-1	CCR5	CXCR5	FOXP3	CD1c	IL-10
PE-Cy7	CD11c	CD11c	IgG	CD83	CD20	CD161	CD127	CD127	CD11c	MIP-1α
BUV395	CD58	CD38	CD38	CD38	CD38	IFN-γ	CD38	CD31		
BUV805	CD20	CD20	CD20	CD20	CD4	CD4	CD4	CD4	CD20	CD20

Act: Activation

CCR: CC chemokine receptors

CD: Cluster of Differentiation

CXCR: CXC chemokine receptors

Cyto: Cytokines

FOXP3: Forkhead box P3

GM-CSF: Granulocyte-macrophage colony-stimulating factor

GITR: Glucocorticoid-induced TNFR-related protein

HLA: Human Leukocyte Antigen

ICOS: Inducible T-cell COStimulator

IFN: Interferon

Ig: immunoglobulin

Lin: Linage (CD3, CD14 and CD16)

IL: InterLeukin

IP: Immunophenotyping

KLRG-1: Killer cell Lectin-like Receptor subfamily G member 1

MΦ: Monocyte

MCP: Monocyte Chemoattractant Protein

MerTk: MER Tyrosine Kinase

MIP: Macrophage inflammatory protein

PD-1: Programmed cell death protein 1

RTE: Recent Thymic Emigrant

TCR: T cell receptor

Tfh: Follicular T cells

TNF: Tumor necrosis factor

Treg: Regulatory T cells